Electrical World

APRIL 13, 1946

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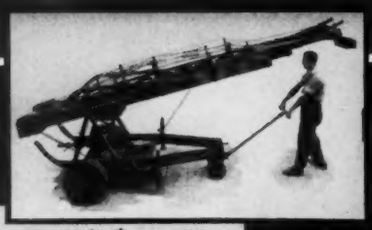

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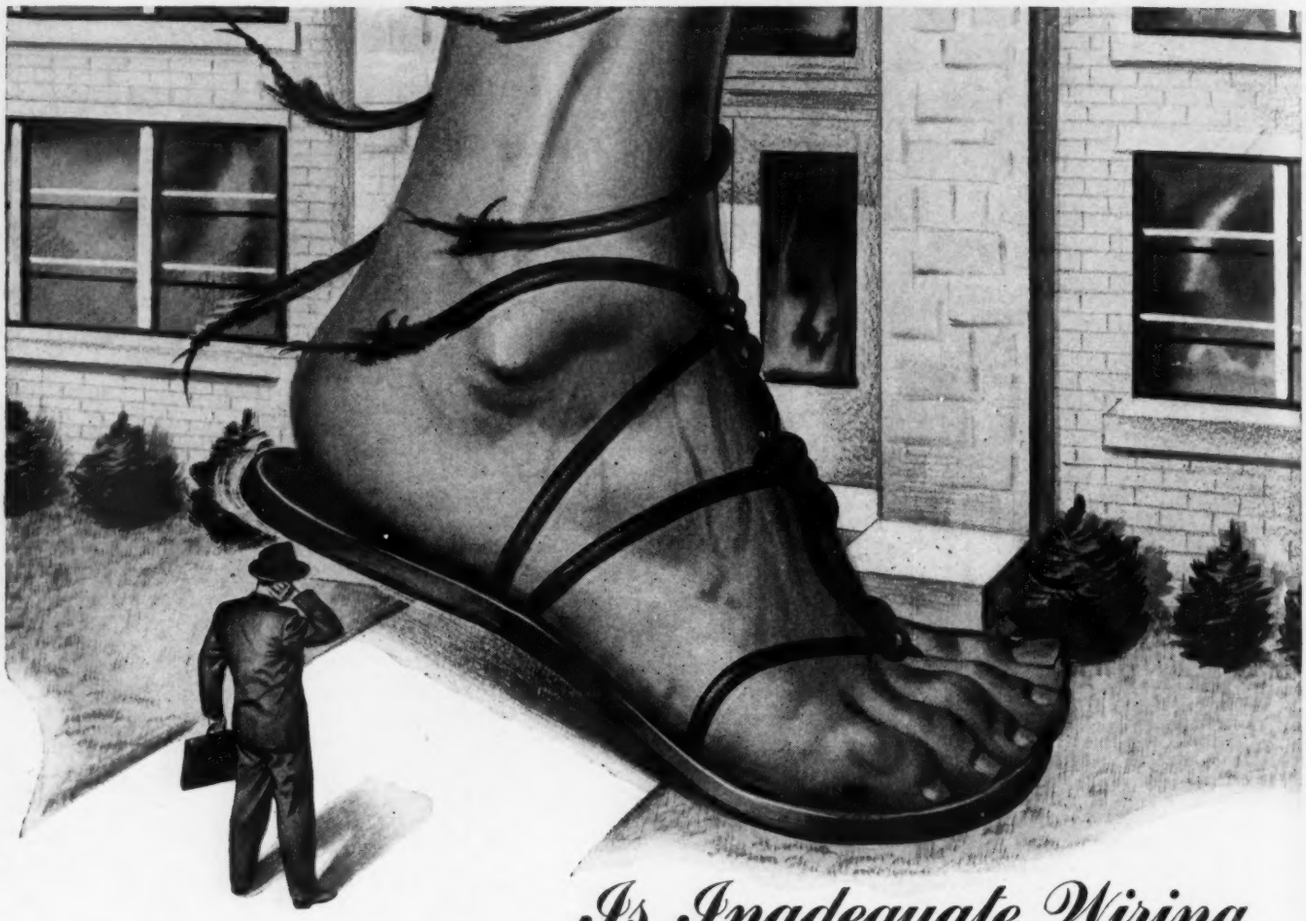

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Electrical World

APRIL 13, 1946

Honors

AT LONG LAST the contributions of the electric utility industry to the war program are being officially recognized by the Armed Forces. At suitable ceremonies in Chicago last week the Navy cited the first group of power companies to be thus honored, and within the next few weeks the major part of the industry, both public and private, will be similarly honored in other areas. At the same time plans are under way by the Army for honoring individual utility employees for their contribution to the successful operation of the Utilities Wartime Aid Program.

A special significance attaches to these citations. Unlike the Army-Navy "E" awards made to manufacturing plants and their workers as an "incentive bonus" for war production, the citations to utilities and their people are solely in appreciation for services rendered.

Although light and power company employees sometimes wondered why they too could not earn an Army-Navy "E", it was a tribute to their loyalty to the job that no other incentive was necessary.

During the war there was no strike in the entire electric utility industry that curtailed war production. What other major war industry can make such a claim? There was no shortage of power. In fact, regardless of the demand, power was ready and always available where needed.

It was the Chief of Engineers of the Army, Lieut. General Raymond A. Wheeler, who summed this up just last week at the Midwest Power Conference when he gave a soldier's thanks for the contribution to victory made by the power industry, saying:

"I know of no greater cooperation in the stress of most urgent need than that evidenced by those engaged in the production and distribution of power. They met the balooning demands of the military establishments for electric energy at the same time that they were satisfying the demands of rapidly expanding private industry geared to war production."

The demands of the country for power are becoming even more active than during the peak of war production. Will we always be able to say that the power behind the worker in this country exceeds that of any other nation in the world? Will we always maintain our position as the foremost country in the world in power supply and energy utilization? This is the backbone of our national defense and perhaps as well of our national economy in terms of international competition.

No industry contributed more to victory than did the electric utility industry, and if increased productivity per factory worker is the way to forestall inflation, then no industry has the opportunity to contribute so greatly to maintaining and improving our national economy. Peace, in other words, presents a greater challenge than did war. Instead of honors from a grateful nation for helping to win the battle of peace there may be threats of competition or nationalization, but come what may there will always be the satisfaction of having done a good job.

It is this inner feeling of pride in contributing to human welfare and comfort that has always driven the people of the light and power industry on to bigger things. The reward that will come in peace will still be the knowledge that electric service is doing its part in fashioning a better national economy and a better place in which to work and live.

Gas Turbine Operates Experimentally at 1,350 F.

Developmental 3,500-hp. unit designed for ultimate operation at 1,500 F. has reached 1,350 F. satisfactorily in comprehensive investigation of metals, combustion, losses and thermal behavior of the assembly

I. Objectives of Experimental Design

J. T. RETTALIATA, Consulting Engineer, Allis-Chalmers Mfg. Co.

RECOGNIZING THE NEED for a gas turbine test unit capable of testing high temperature materials under actual full-scale service conditions, the Bureau of Ships of the U. S. Navy directed the Allis-Chalmers Mfg. Co. to design and construct a 3,500-hp. experimental gas turbine unit capable of operating at temperatures up to 1,500 F.

This experimental unit has been under test for almost two years to date, operating at progressively increasing turbine inlet temperatures, and has just recently and satisfactorily completed a series of test runs at 1,350 F., reportedly the highest operating temperature ever reached in a stationary unit of this size.

Objectives

In pushing forward the commercial horizon of the gas turbine, it is necessary that multiple stage turbines be developed for reliable operation where the inlet temperature is 1,500 F. The Annapolis unit is designed to supply information to guide the designers of future gas turbines for this operating temperature.

The extreme high temperature of piping and the consequent increase of linear dimension require special provision for the expansion of this pipe. A special type of expansion joint is used at several points in the installation in which the expansion is accommodated by the rotation of the adjoining members of the expansion joint.

High temperature piping is designed with an inner skin or gas conducting member over the walls of which there is no pressure difference. Mineral block insulation between the inner and outer wall establishes the temperature drop whereby the outer wall is cooled sufficiently to maintain the necessary physical strength.

Being an entirely experimental gas turbine unit, thermal efficiency was not given first consideration in its design. In this project, flexibility of operation, ease of taking essential research data at hundreds of points during each test run, and the facility of complete disassembly of any or all component parts for scheduled inspections as the tests progressed dictated the arrangement of parts finally adopted.

Thermal expansion alone required provisions in the combustion chambers, piping, and turbines for each foot of the metal to expand over one-eighth of an inch in all directions when heated to 1,500 F. and still remain pressure tight with an internal pressure of 45 psi. This movement had to be allowed without throwing any strains on the turbine casing. Provisions were also made to cool the bearing pedestals to prevent misalignment of the bearings during high temperature runs on the unit.

The cycle selected for this experimental gas turbine power unit is known as the parallel turbine regenerative cycle. Air enters the gas genera-

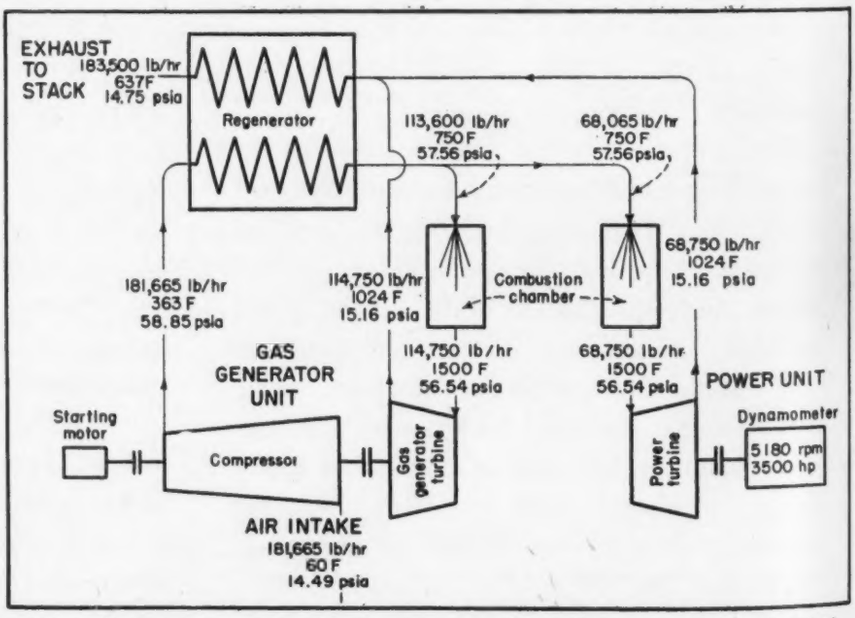


FIG. 1—Regenerative cycle with separate gas turbines for compression and output. Data indicated at the various points are for full load conditions

tor compressor at atmospheric pressure in which it is compressed to 45 psi. gage pressure. The compressed air then enters the heat exchanger where, at full load, it is heated by the turbine exhaust gas from a temperature of 363 F. at the compressor discharge to a temperature of 750 F. at the entrance to the combustion chambers. After leaving the heat exchanger, the preheated air flows directly downward into the two horizontal combustion chambers, one of which supplies the gas generator turbine driving the compressor and the other of which supplies the power turbine. With this arrangement it is possible independently to control the power generated by the gas generator and power turbines, an operational advantage essential to shipboard operation.

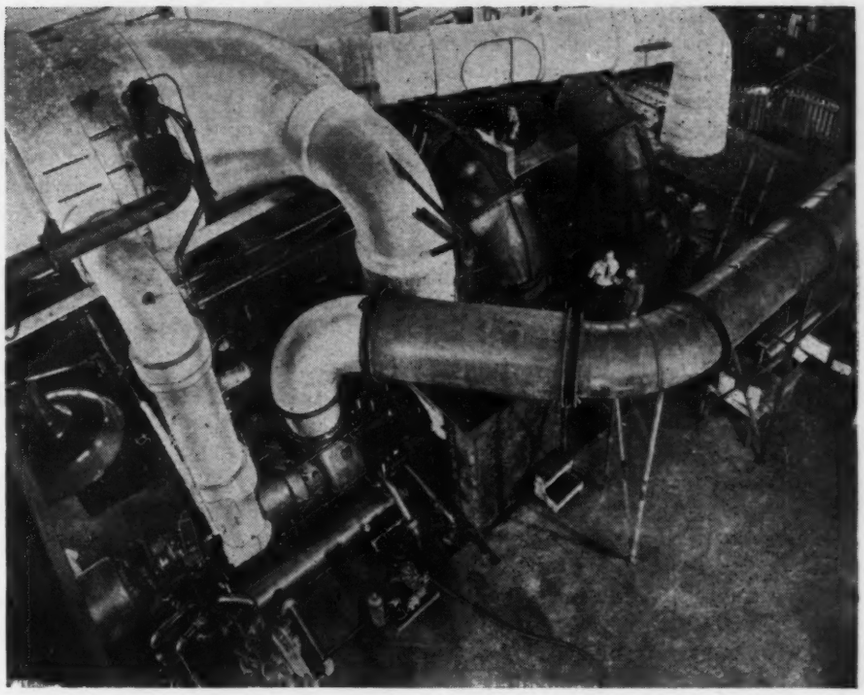


FIG. 2—100-hp. motor at left runs unit up to 2,200 rpm. for starting, then declutched. Dynamometer or water brake for output tests is shown at right

Compressor and Regenerator

In the axial-flow air compressor there are 20 stages of airfoil section blades, so arranged that the air is accelerated by the moving blades and then slowed down in the stationary elements in such a manner that part of the velocity energy is converted into pressure. This compressor runs at very high efficiency, of the order of 85 percent when compressing the full load volume of 40,000 cu. ft. of air per minute against the operating head of 45 psi. gage pressure.

The regenerator has an external heating surface of 8,500 sq. ft., and is designed to have an effectiveness of approximately 60 percent with relatively low pressure drops on the air and gas sides.

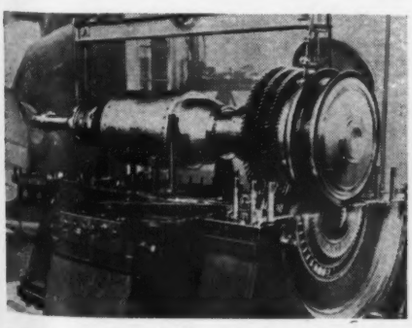


FIG. 3—Gas turbine spindle with overhung disks and counterbalance of experimental unit at Annapolis test station

Each of the two combustion chambers is supplied with a single oil burner in which the liquid fuel is broken up by mechanical atomization into extremely fine particles to promote rapid burning. The central flame tube is arranged to pass the proportion of the air flow necessary to support and complete combustion. The remainder of the air flows between the flame tube and the outer wall of the combustion chamber, thereby reducing the temperature of the flame tube to a safe operating level, and at the same time avoiding the use of refractory brickwork. The cooling air and combustion gases are then intimately mixed by allowing the oppositely whirling concentric streams to come together at the end of the flame tube.

Heat release in these combustion chambers at full design load is approximately 2,500,000 B.t.u. per cu. ft. per hr., which is several times the heat release of the ordinary high capacity central station boiler.

In the extremely simple arrangement of the combustion system, the air leaving the axial flow compressor first passes through the regenerator where it picks up waste heat from the turbine exhaust gases. The gas is further heated by the burning of fuel directly in the air stream. The form of the combustion chamber and the use of the air cooled flame tube make unnecessary the use of brickwork, hence the unit will respond quickly to load changes, during which the power demands are met by the simple manual opening or closing of the two fuel valves.

Gas Turbines

Each turbine has five pressure stages and operates at 5,200 rpm. at full load. The first two stages are of the impulse type in which the expansions from the upper to the lower stage pressures are substantially completed in each complete ring of nozzles which directs the high velocity gases on to the crescent shaped moving blades. A diaphragm carries the nozzles that separate the first and second impulse stages.

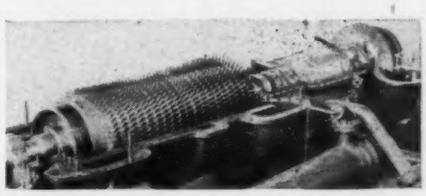


FIG. 4—Axial flow compressor runs pressures up to 45 psi gage

The last three stages are of the conventional reaction type. The last reaction stage discharges the gas to the turbine exhaust chamber where it passes to the regenerator and then to the atmosphere.

Blades and disks of the turbines are constructed of a recently developed high temperature Timken alloy steel,

which includes 16 percent chromium, 25 percent nickel, and 6 percent molybdenum. This was developed for use particularly in the Annapolis unit, and has also had extensive service in superchargers and jet propulsion engines during the recent war. The heavy stationary parts of the turbines are made of an alloy steel containing 25 percent chromium and 12 percent nickel.

Piping

The air intake pipe is 36 in. in inside diameter, and the exhaust opening of the gas generator turbine is 42 in. in diameter in spite of rather high gas velocities. The pipes leading from the combustion chambers to the turbines appear large because the insulation necessary to withstand the hot gases at 1,500 F. is inside between the double-wall construction.

The swing type expansion joints installed in the piping are of major importance due to the great amount of thermal expansion that takes place between room temperature and the high initial temperatures at which the unit operates. These joints consist of a series of radially placed hinges between the flanges, the arrangement being such that the rotation of the adjoining members operates to relieve the dimensional changes of the piping resulting from thermal expansion without the distortion of turbine and compressor parts that would otherwise occur.

Test Results

Both the gas generator turbine and the power turbine were operated at full speed of 5,200 rpm. for over 50 hr. in November, 1945, with exceedingly smooth operation and subsequent examination revealed an excellent condition of all parts. These runs were made with 1,200 F. inlet temperature on the power turbine and 1,100 F. on the gas generator turbine.

Continuing the test schedule, 50-hr. runs were recently made with inlet temperatures of 1,350 F. on the power turbine and 1,200 F. on the gas generator turbine, again with very smooth operation and no serious complications or indications of distress in the high temperature rotating elements.

The unit has been in operation over 500 hr. to date in accordance with the rigorous test schedule. This gas turbine is an experimental one, designed particularly to obtain necessary information on the endurance life of gas turbine units with inlet temperatures up to 1500 F., and to that end it has performed satisfactorily to date.

Occasional minor mishaps have developed during the testing, but so far these have been overcome without serious difficulty, and the unit is delivering its expected performance.

The tests completed so far have yielded much information which has heretofore never existed, particularly in regard to axial flow compressor characteristics over a wide range of operation. Eventually, a complete report of the project will be published, but as heretofore indicated, the obtaining of test data on a unit of this type will require a considerable length of time. This is in the nature of a progress report giving the present status of the project.

II. Instrumentation and Testing Techniques

C. F. KOTTCAMP, Lieutenant Commander, USNR

To obtain the information which the Standards and Test Division of the Bureau of Ships desires from this gas turbine investigation, it was necessary for the Engineering Experiment Station to develop an instrumentation and test program which we feel is unprecedented in the gas turbine field.

The original test authorization of the Bureau of Ships requested that the station determine over-all performance of the plant as well as the performances of the individual machinery items, that is, the turbines, compressor, combustion chambers, the regenerator and also determine piping losses. The Bureau stipulated the accuracies desired for the various test items, and the investigation of the performance of individual machinery units was to be of sufficient accuracy to yield data as to their efficiencies and power requirements to within ± 1 percent. To obtain this information instrumentation accuracies were specified as follows:

(A) Temperatures—(a) up to 500 F. ±1 F. (b) 500 to 1,000 F. ±2 F. (c) 1,000 to 1,500 F. ±3 F.

(B) Pressures—(a) up to 30 psia. ±0.03 in. Hg. (b) above 30 psia. ±0.1 in. Hg.

(C) Flow Readings—(a) fuel ±0.1 percent. (b) inlet air flow ±0.5 percent. (c) turbine gas flow ±1 percent.

(D) Torque Output of Power Turbine ±0.25 percent.

(E) Rotational Speed—Since speed is the primary variable for evaluation of compressor performance and is also the primary reference against which all test data will be plotted, it was important that it be determined as accurately as possible, and a desired accuracy of 0.1 percent was set.

After several months of basic study, a satisfactory solution to the temperature measurement problem was reached with the development by Experiment Station's gas turbine division of a probe-type thermocouple completely built into a ⅜-in. stabilized 18-8 stainless steel tube. By using this thermocouple in the gas duct leading to the turbine inlet and accurately measuring the duct wall temperature, we believe we can safely say that (by mathematically correcting for the thermocouple radiation losses) we can obtain the gas stream temperature within ± 4 F. at 1,500 F.

For temperature measurement alone, it was necessary to install 66 thermocouples distributed throughout the unit and utilize nearly a mile of thermocouple wire and cable in their interconnecting thermo-electric circuits. A total of 72 mercury-in-glass thermometers was installed at various locations to obtain temperatures of fluids flowing in miscellaneous air, oil, and water lines. A total of 49 test pressure gages and 44 manometers requiring approximately 3,500 ft. of ¼-in. connecting copper tubing was also installed.

For a complete set of readings the test crew was organized so that seven men required only 20 minutes to record a total of 261 readings on 33 separate data sheets. In addition, one observer recorded, within a half hour, a total of 58 thermal expansion measurements.

During the seven-hour test period, approximately 2,000 individual readings were systematically recorded.

Safe Discharge of A. C. Power Capacitors

Provisions made and precautions to take toward discharge of energy left stored in capacitors—Discharge by natural leakage, permanent resistors and reactors, by automatically connected resistors and by direct shorting—Little known facts about residual energy in capacitors

R. L. FANCHER, Westinghouse Electric Corp., East Pittsburgh, Pa.*

PROPER DISCHARGE of a.c. power capacitor installations is a particularly important consideration, for it is in such installations that the heaviest concentrations of stored energy are found. These installations vary in size from a single 15-kva. capacitor unit to hundreds of these units connected in parallel with the load for power factor correction to give over-all installation ratings up to 15,000 kva. Capacitors also may be connected in series with the load to counterbalance reactive voltage drop. They may be located in industrial plants near the load, on distribution circuits or at substations.

Energy Stored in Capacitors

The voltage which an a.c. capacitor retains after being disconnected from its circuit is equal to the peak voltage applied to its terminals immediately before the circuit interruption, since the capacitor current leads the capacitor voltage by 90 deg. and a.c. current interrupters operate to open the circuit at a current zero.

One phase of a delta-connected capacitor bank will retain a peak line-to-line voltage charge when the bank is removed from the line, while the two remaining phases will be charged to one-half this voltage. A grounded, wye-connected bank will retain a peak line-to-neutral voltage charge on each phase. However, in the event the bank is not grounded, two of these phases will be charged only to one-half peak line-to-line voltage. This analysis of the voltage retained by capacitors after removal from the line is theoretically accurate and will be found to apply in the vast majority of capacitor switching operations, regardless of the type of circuit interrupter employed. It should be assumed to apply in every instance since it represents the worst possible conditions so far as energy storage and resulting dangers to operating personnel are concerned.

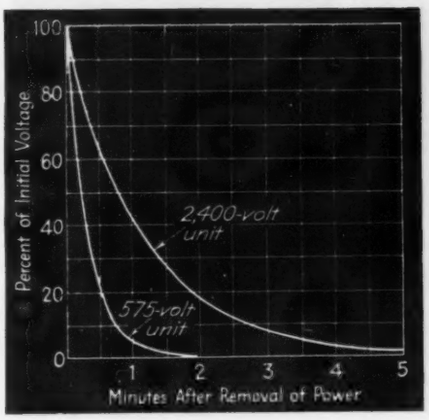


FIG. 1—Discharge of a.c. power capacitor units through their internal resistors. The lower curve is representative of ratings of 600 volts and below, the upper of ratings above 600 volts

Electrical energy, W, in watt-seconds, stored by a 60-cycle capacitor bank upon interruption of operation at its rated voltage is given by

$$W = 2.65 \text{ kva.}$$

for single-phase and grounded wye banks, where the kva. referred to is the total rated kva. of the bank. For an ungrounded wye bank the stored energy will be 83.5 percent and for a delta bank 50 percent of that given by this equation. The smaller quantities of energy stored by these two types of banks result from the retention of a voltage charge of less than peak rated voltage by two of the phases, as stated above. The total energy stored by the bank will be distributed among the phases in such a way that the percentage of the total energy stored by a given phase is proportional to the square of the voltage retained by that phase.

Natural Discharge of Capacitors

If no other means is provided, a charged capacitor of C microfarads will not retain its energy indefinitely, but will discharge through its own internal insulation resistance of R megohms according to the relation

$$E = E_o e^{-\frac{t}{RC}}$$

where E_o is the initial voltage charge, E is the voltage at time t seconds, after the initiation of the discharge, and e is the base of natural logarithms, 2.718.

The product of insulation resistance and capacitance of a paper-dielectric capacitor is not a function of its kva. or voltage ratings but is a constant, since the insulation varies directly as the thickness of insulation between the foil electrodes and inversely as the area of this insulation while the capacitance varies directly with the area and inversely as the insulation thickness. In present day a.c. power capacitors, the product of insulation resistance and capacitance gives an RC value of not less than 2,000 megohm microfarads at 25 deg. C.

Substituting this value of RC in the equation above, it is found that 2 hr.

* Capacitor Engineer, Switchgear and Control Division.

and 20 min. are required to discharge a 2,400-volt capacitor to 50 volts, regardless of kva. rating, assuming an initial charge to a peak value of 3,390 volts. Similarly, 1½ hr. are required for the discharge of a 575-volt capacitor from peak to 50 volts. In order to bring the capacitor voltages down to a safe value within a reasonable time, discharge devices are usually provided.

Several schemes are used for discharging capacitors before they are handled, the scheme used for a given installation depending upon the requirments of that particular application.

Resistors Permanently Connected

For example, most power factor correction capacitors and series capacitors for transmission lines and distribution circuits have internal discharge resistors connected in parallel with the capacitor element. These resistors are dried and impregnated with the capacitor and are ordinarily ceramic resistors of the order of several megohms, drawing approximately 1 watt of power while the capacitor is operating at rated voltage. The value of resistance is chosen such that discharge from peak to 50 volts occurs within 1 min. after removal from the line for capacitors rated at 600 volts or less and within 5 min. for capacitors rated above 600 volts.

The National Electrical Code requires that capacitors which are installed in industrial plants be discharged to 50 volts within 1 min. after disconnection from the line. However, for capacitors installed by electric service companies, which are not covered by the Code, a 5-min. discharge has been generally acceptable in so far as safety of operation is concerned.

When a capacitor is temporarily discharged, either instantaneously by direct shorting or over a period of a few minutes through a higher impedance, it does not release its entire charge immediately even though the capacitor voltage is reduced to zero by the discharge. Through the phenomenon of dielectric absorption, a part of the initial stored energy is subsequently released and builds up across the capacitor terminals a voltage which is low relative to the original voltage. Use of permanently connected, internal-discharge resistors prevents this voltage build-up which would otherwise occur in such cases as during shipment of capacitors from the factory to the customer or after removal of a capacitor unit from its rack where the external discharge reactor would ordinarily be depended on for the discharge of the unit.

Reactors Permanently Connected

In many electric service company installations, considerations entirely apart from the safety of the operator dictate a discharge time of 1 min. or less. For example, automatically

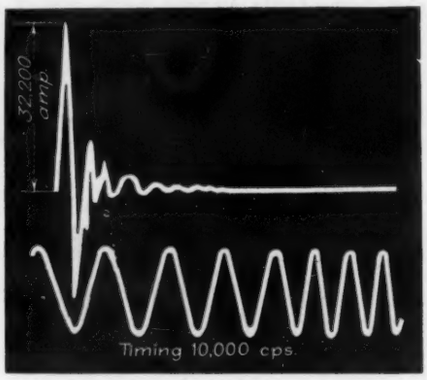


FIG. 2—Discharge current resulting from the direct shorting of a single-phase, 575-volt, 15-kva. (120 mfd.) capacitor unit having an initial charge of 115 volts

switched installations are equipped with the time delays which block reconnection to the line before approximately 1 min. after the capacitors are taken off in order to prevent repetitive switching in response to rapidly fluctuating circuit conditions. These capacitor installations, particularly the larger ones, should never be thrown on the line while in a highly charged condition because of the resulting voltage transients and extremely high in-

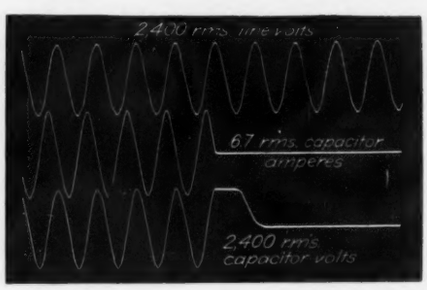


FIG. 3—Removal of single-phase, 2,400-volt, 60-cycle, 15-kva. capacitor unit from line by opening fuse cutout. Circuit interruption occurs at current zero, leaving capacitor charged to peak voltage. The actual change in the capacitor voltage during discharge is distorted because the unidirectional voltage was measured through a potential transformer

rush currents which increase breaker maintenance and necessitate use of larger fuses than would otherwise be required.

However, it is undesirable in many cases to hold the equipment off the line until the elapse of the 5-min. discharge period required by the individual internal discharge resistors of the higher voltage units. Consequently, capacitor installations in which these units are used are usually discharged through externally mounted reactors permanently connected in parallel with the capacitor units, which reduce the capacitor voltage to a negligible value within a few seconds to approximately 1 min., depending on the size of the installation.

The discharge device is mounted externally due to design difficulties inherent in the use of internal dischargers for such rapid discharge of capacitor units rated above 660 volts. Reactors are used because of their high 60-cycle impedance and resulting low power consumption while the capacitors are operating and their low impedance to the direct current discharge of the capacitors after their removal from the line. In capacitor installations where potential transformers are used for relaying or metering purposes, no special reactors are required since the transformers serve as excellent dischargers.

Where external discharge reactors are used on delta-connected groups of units, only two reactors, connected in open delta, are required to assure complete discharge. For a wye-connected group, three reactors connected line-to-neutral across the capacitors are required.

In the past, reactors have been applied to capacitor equipments for which a 1 min. or faster discharge was required but where this time could not be met through the use of the internal discharge resistors alone. These applications have included both automatically and manually switched capacitor banks where the more rapid discharge was necessary for the limitation of inrush current, and industrial equipments where the primary consideration was adherence to the National Electrical Code requirements.

Automatically Connected Resistors

In addition to the permanently connected reactors and resistors discussed above, a third method for discharging

capacitors has found limited application. This is the use of a resistor which is automatically connected across the capacitor bank when its discharge is desired. This method of discharge finds is greatest application on series capacitors for resistance welders where, in order to obtain consistently good results in welds of short duration, the capacitors must retain their charge between welds, thus precluding the use of a permanently connected discharge device. Through an electrical interlock, a resistor is connected across the capacitor bank when the welder circuit breaker is opened. This scheme is entirely satisfactory but obviously more expensive than a permanently connected discharge device and consequently is used only in special applications.

Direct Shorting

A fourth and least desirable of all the methods of discharging capacitors is direct shorting between terminals after removal from the line. The objections to the general and exclusive use of this method are its inconvenience and the likelihood that it would be forgotten were it a manual operation. The principal objections, however, whether the shorting is an automatic or a manual process, is the potentially destructive effects of the heavy discharge currents obtained.

Whenever a capacitor of C microfarads is discharged through a circuit having an inductance of L henrys and a resistance of R ohms, the discharge will be non-oscillatory if R^2 is greater than 4L/C, and the discharge oscillatory if it is less. When the discharge is through a direct short, the discharge is usually oscillatory since the resistance is very low. The discharge frequency in this case is approximately equal to the resonant frequency determined by the L and C of the circuit, and negligible impedance will be offered to the discharge current by this series resonant circuit. Consequently, extremely high momentary currents are obtained. For example, as shown in Fig. 2, a peak discharge current of 32,220 amp. was obtained through the direct shorting of a single-phase, 575-volt, 15-kva. (120-microfarad) capacitor charged to only 115 volts. The rapid decay of the discharge current wave results from the dissipation of energy in the circuit resistance.

Although the direct shorting of charged capacitors is not recommended, this discharge means may be employed on small installations where it is inconvenient to wait for the normal discharge through the internal resistors, provided certain precautions are taken. A shorting device consisting of a short crossarm of copper bar fixed to the end of an insulating handle may be employed, but regardless of the methods used, the short should not be made at the terminal studs of a capacitor unit. It should, instead, be made at a point on the capacitor leads or bus where the detrimental effects of a possible arc will be minimized. If the conductors at the point at which the discharge is made are No. 4 or larger, and the capacitor bank is rated at 180 kva. or less, there is little danger of damaging the conductors. However, for larger banks or smaller conductors, wrapping of short sections of the conductors with another smaller conductor may be warranted to form special discharge points.

Floating Potential

A capacitor unit in addition to having capacitance between terminals also has a smaller capacitance between terminals and case. This latter capacitance in combination with the capacitance from case to ground will cause the case to float at some potential above ground in the event the unit is installed on a grounded system. To eliminate this hazard to maintenance personnel, the capacitor cases and supporting racks should be permanently grounded in installations on this type of system.

The direct shorting of a capacitor unit at relatively rare intervals will not damage the unit internally in any way. However, when practicable, capacitor equipments should be allowed to discharge through their own discharge resistors or reactors. Then for absolute safety, each phase should always be temporarily short circuited and grounded as an added precaution before work on the installation is begun. It is important that each phase be shorted individually in order that complete discharge of the equipment will be obtained. In addition, the grounding of the terminals to the case should never be omitted, since no other means for draining the residual charge from the terminal-to-case capacitance is provided.

• • •

British Grid Control Room Underground

Almost complete devastation of the area surrounding the Central Electricity Board's grid control center near the Bankside power station made it necessary to seek safer quarters for this vital nerve center. Two unused elevator shafts at one of the underground railway stations were made available in October, 1940, and by March, 1941, the former surface control center was completely vacated.

Details given in the *Electrical Review* for June 8, 1945, disclose that thirteen rooms were constructed in the two shafts each 120 ft. deep and 23 ft. in diameter. They were lined with 18 in. of reinforced concrete as protection against side blast from deep penetration bombs. Protection against direct hits is provided by a "bomb-stopper" consisting of 12 ft. of reinforced concrete on three slabs separated by 9 ft. of air space and 14 ft. of blast-absorbing ballast; over-all depth 35 ft. Other bomb-stoppers protect the access stairway and the ventilating shaft.

All the space below the level of the bomb-stoppers is air-conditioned; the ventilating system includes cotton-wool dust filters and special poison-gas filters.

One room is devoted to switching control and the other to loading control; they are connected by a passage about 8 ft. long which links the two shafts. The system diagrams are perforce cylindrical but this was easy to arrange because the panels consist of 41,000-in. squares of plastic mounted on 6-in. steel strips. The diagram can be changed to reflect system changes merely by moving the squares to other positions.

To overcome the inability of the operating engineers to "feel" the weather in the conditioned underground space, light-intensity indicators and weather recording instruments were fitted to the load-control desk.

A separate room is set apart for network calculations and is provided with short-circuit, load-flow and universal calculating boards.

Simple Network Analyzer Modified for Coupled Faults

Limitations of d.c. calculating boards are overcome in modified version using 60 cycles a.c.—Equipment has value in supplementing a.c. network analyzers and to small systems unable to afford expensive a.c. calculating boards—Modifications cover unbalanced faults

MARTIN J. LANTZ, Engineer, Bonneville Power Administration, Portland, Ore.

MANY short-circuit problems may be solved on the d.c. calculating board. Principal limitation of the ordinary d.c. board is its inability to represent the mutual induction during unbalanced faults to ground between lines of different voltages, or between lines not bussed at both ends. A modification of the d.c. board which overcomes some of the limitations of the conventional board and broadens its scope to the solution of more complicated short-circuit problems is herein described.

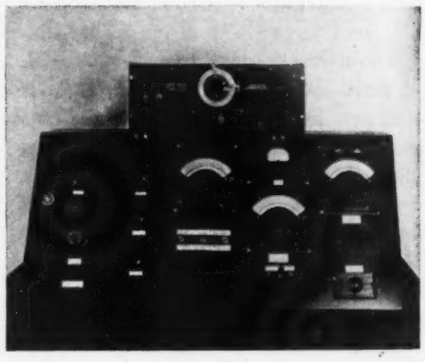
Modified Calculating Board

The modified calculating board uses 60-cycle a.c. as a power source, thus permitting the use of one-to-one ratio transformers on the zero-sequence network to represent mutual induction for the more complicated circuits. It is of the fixed system type. The complete board consists of the positive-sequence section, the zero-sequence section, the variable section, the control panel, the power unit, and a d.c. resistance bridge.

A constant potential of 20 volts is applied to the board. A "variac" in the primary of the power transformer provides for voltage adjustment; 25-watt, slidewire-adjusted resistors are used to represent the various system reactances. Use of these inexpensive low-wattage resistors more than compensates for the added expense of the low- current a.c. metering system which is required.

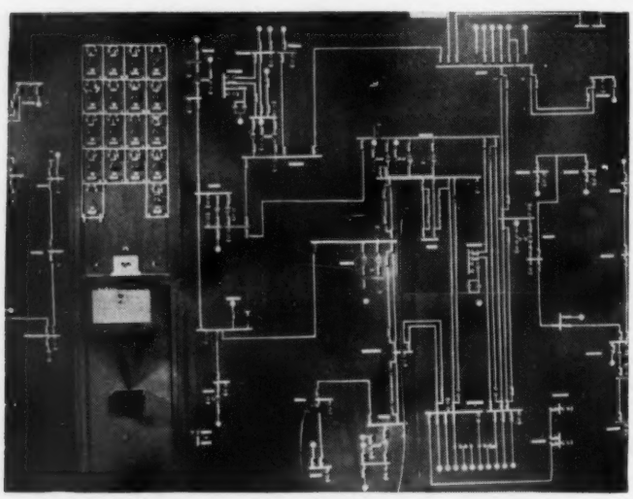
A separate grounding jack is brought out to each bus to facilitate the placing of a fault, thus eliminating the fault cords. (Fig. 1) Two plugs are bolted into a copper bar forming a shorting plug to place in each circuit as desired. Plugs must be inserted in the jacks at both ends of a line to complete the circuit.

A pair of jacks located at the center of each board is brought out from the ammeter in the control panel. Total fault current may be measured by inserting the ammeter in the jacks occupied by the fault plug.



CONTROL PANEL and voltage amplifier (on top) for modified d.c. calculating board supplied by constant potential

A set of four jacks and one plug provides a simple means for the changing of board combinations to simulate different types of faults. One position is for three-phase faults, a second position connects the two boards in series for single-phase-to-ground faults, and a third position makes it possible to place a controlled voltage on the zero-sequence board to measure the zero-sequence network resistance of a desired fault by the voltmeter-ammeter method. If the network resistance were measured by the bridge, an error might be introduced due to the mutual transformers.



FRONT VIEW of modified short-circuit board showing portions of zero- and positive-sequence boards, variable section and d.c. resistance bridge. Slidewire resistors represent reactances

Parallel Lines

Consideration of the effect of mutual induction on parallel lines for unbalanced faults is accomplished on the modified short-circuit board as follows:

1. When two lines operate at the same voltage and are bussed at one

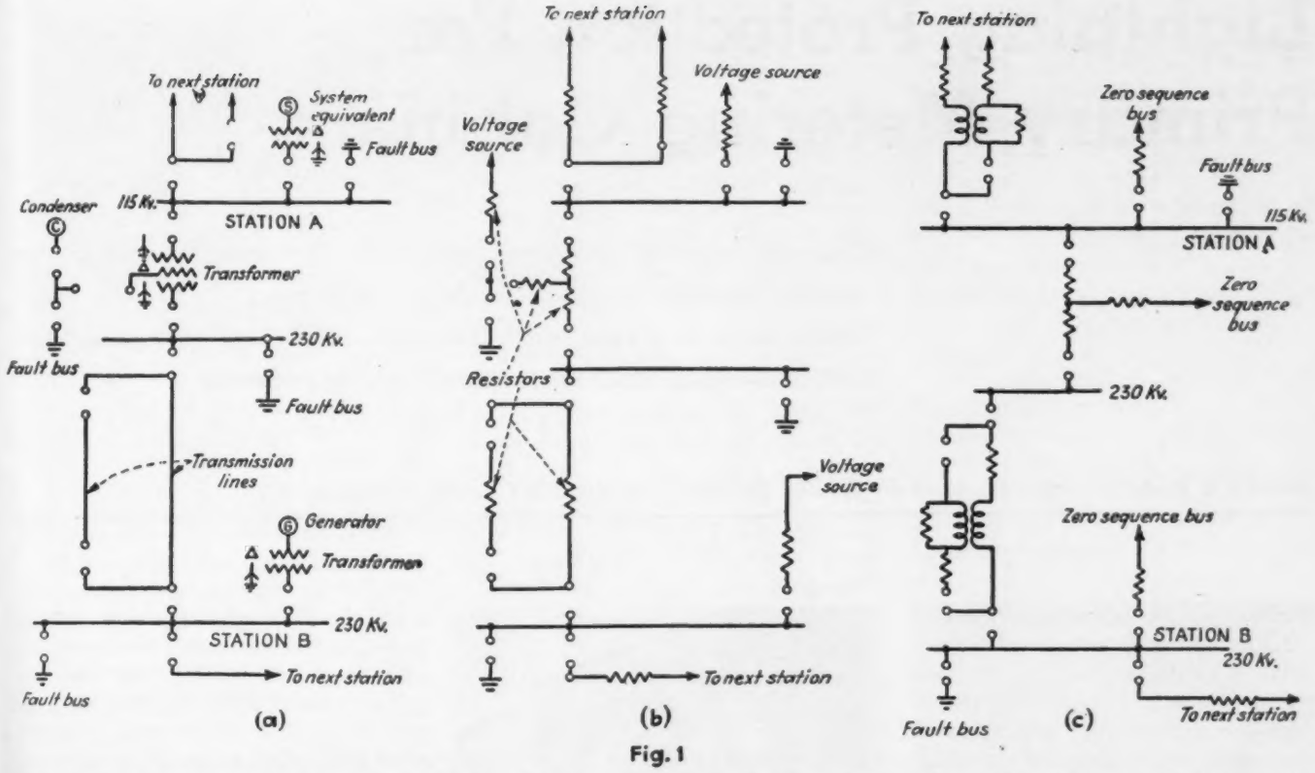


Fig. 1

FIG. 1—Section of panel, positive-sequence board. a–Front view schematic diagram. b–Rear view wiring diagram positive-sequence network. c–Rear view wiring diagram, zero-sequence network section of panel

end, they may be represented by an equivalent circuit (Fig. 2a). The equivalent impedance is determined by subtracting the mutual impedance from the zero-sequence impedance of each line and adding it as a common impedance. This equivalent is adapted to the board (Fig. 2b) so that a line may be faulted with its breaker adjacent to the respective bus in an open position.

2. For use on parallel circuits of different voltages, or where a split bus is involved, a transformer with one-to-one ratio is used with one winding in each line. Shunting an impedance equal to the mutual impedance across either winding of this transformer produces a voltage drop proportional to the mutual induction when current flows. This voltage is reflected to the coupled circuit, and induces a current in the opposite direction to the originating current. Either side of the transformers may be shunted.

Variable Section

A variable section has been built so that temporary units may be connected to the fixed network to represent proposed system changes. It consists of eighteen variable units each composed of a rheostat and terminals for the connection of various size fixed resistors to increase the range of the rheostats.

Mounted on the front of the variable section is a d.c. bridge for measuring the resistance values for adjusting units of the variable section. The bridge is also used from this position to measure the equivalent resistance of the positive-sequence network to any point of fault.

The ratio of the ohmic values of the resistors in the network to the resistance of a.c. ammeters is relatively small in many cases. In such instances the insertion of a substantial meter resistance in series with a low value network resistor introduces an appreciable error. This is particularly true of a.c. meters reading small values of current. To reduce this error to a reasonable value, a rather elaborate metering system is used which requires a voltage amplifier. The voltage drop across a low resistance shunt placed in the circuit to be measured is fed into the voltage amplifier, whose output is connected to an a.c. milliammeter.

The control panel contains most of the controls for operation of the board and the metering system. The amplifier is mounted on top of the panel.

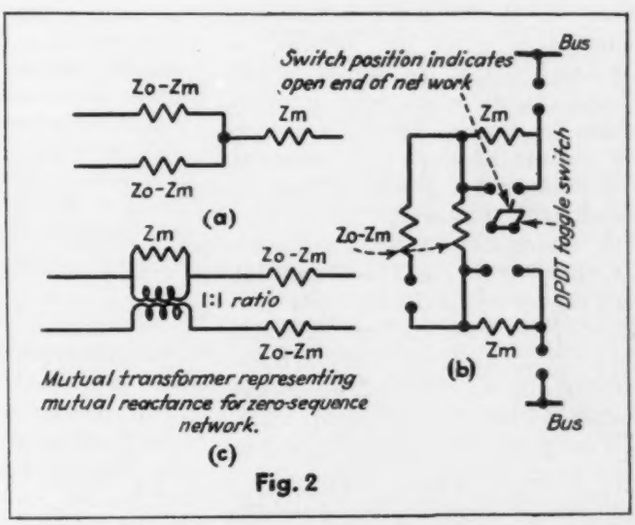


Fig. 2

FIG. 2—a–Equivalent circuit representing mutual reactance for zero-sequence network. b–Application of equivalent circuit to zero-sequence board. c–Mutual transformer representing mutual reactance for zero-sequence network

Lightning Protection For Primary Metering Cabinets

Company provides instrument transformers on grids for insertion in outdoor cabinets—Arresters inside cabinets avert destructive surge-current drops in ground lead—Instrument transformer failures substantially reduced—Cutouts now mounted on pole crossarm

ROBERT PFAFF* and H. N. EKVALL†, Philadelphia Electric Co., Philadelphia, Pa.

MODERNIZING primary metering installations through the use of outdoor metal cabinets for housing the high voltage equipment, and application of more effective lightning protection are two improvement activities being carried on simultaneously by the Philadelphia Electric Co. as a matter of interdepartment cooperation. A review of both activities is covered by this article.

Outdoor Cabinets

In line with the trend of the times to combine related equipment into compact units, primary metering transformers for 4-kv., 3-phase and 2.4-kv., 2-phase customers are being assembled into self-contained metal cabinets (Fig. 1) especially designed for outdoor use. In the newer installations lightning arresters are installed in the lower part of the cabinet instead of the cutouts which were formerly within the cabinets but are now located on the terminal pole crossarm. The cabinets are purchased and installed by the customer.

A standard grid or transformer mounting frame (Fig. 2) is installed in each cabinet by the Philadelphia Electric Co. On this grid are mounted indoor type current and potential transformers and standard color-code secondary wiring with terminal block. The entire grid assembly is prefabricated in the company's shop.

By use of the grid, the installation of the primary equipment is greatly facilitated. A device known as a grid lifter was designed to aid installation. This lifting device will be outlined in a subsequent issue.

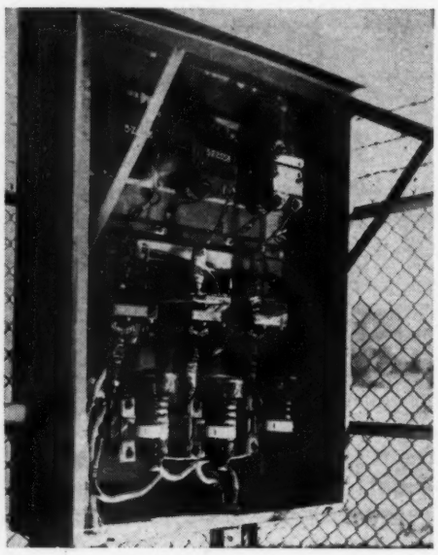


FIG. 1—Standard cabinets (48 x 38 x 12 in., made of No. 14 gage sheet steel) house instrument transformers and most recently the arresters. Front, when raised, forms a shelter. Cutouts now transferred to crossarm on pole

Wiring

On pole type installations, non-metallic sheath cables tap into the aerial circuit and extend down the pole in wood molding. On slab type installations (Fig.1), the cabinets are fed by underground extensions from aerial circuits. About 350 standard outdoor cabinets have been installed since 1937.

Mounting these high voltage cabinets outside the customer's building not only eliminates the high voltage hazard to the customer but saves his valuable indoor space. Only the low voltage metering leads enter the customer's building where the meters are generally housed. Other advantages are (1) ease of installation, (2) quick changing of metering transformers in case of trouble or for customer load changes, (3) permanence of location, (4) visible and ready identification of connections, and (5) standardizations through use of one size cabinet and a shop-wired grid on which indoor type metering transformers are mounted.

Lightning Trouble Experience

Because of insufficient room in the cabinets, the original practice was to install lightning arresters on the crossarm at the top of the terminal pole ahead of the primary cabinet, and to connect the arrester down lead to the cabinet and to a ground rod. Under this condition lightning protection proved unsatisfactory. Approximately 1 percent of the instrument transformers was damaged annually by lightning. At a number of locations cases of trouble were repeated in the same year and at one location as many as eight potential transformers were damaged in four storms. Potential transformers were particularly susceptible to trouble, having about three times the failure rate for current transformers. Most failures involved old-style low-impulse strength equipment.

Theory indicates that the lightning arresters were placed too far from the equipment to provide effective protection. This is illustrated by Fig. 3

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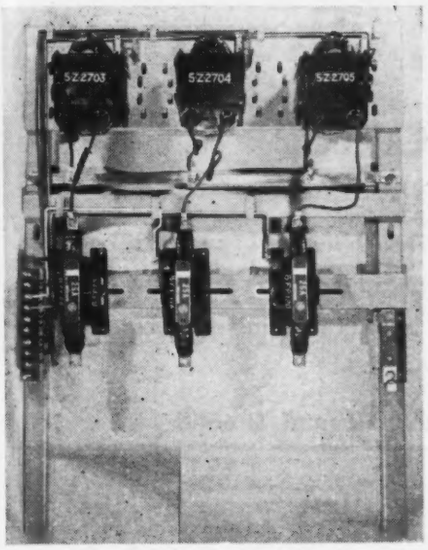


FIG. 2—Transformers and secondary wiring mounted on standard grid (47 x 37 in.) in company's shop. This preassembled unit is lifted into position by means of a grid lifter and block and tackle to the pole-mounted cabinet

which assumes that the lightning surge approaching the arrester reaches a peak value of 5,000 amp. in 2.5 microseconds. When this surge discharges to ground it produces a drop of 18 kv. through the 3-kv. lightning arrester and a drop of 50 kv. in the 10-ohm driven ground. However, with the down lead tied to the cabinet, as indicated above, the voltage drop in the ground is no longer a factor and therefore it would seem that the voltage impressed on the cabinet equipment would be about 18 kv. except for the inductive drop in the down lead. Inductive drops of the order of 3,000 volts per foot of down lead may occur across the 20 ft. of down lead between the arrester and the cabinet. The resultant of this 60 kv. of inductive drop and 18 kv. of largely resistance drop through the arrester is about 62 kv. and this is what is impressed upon the equipment. This is slightly above the basic impulse level of 60 kv. for new equipment in the 5-kv. class. Placing the arresters in the cabinet as shown by the dotted lines in Fig. 3 would largely eliminate the inductive drop of the down lead and should provide better protection.

To confirm these theoretical considerations, tests were made on two cabinet assemblies in the surge testing laboratory of Electric Service Manufacturing Co., Philadelphia. Each was equipped with three 3-kv. lightning arresters connected on the line side of the metering transformers. One cabinet was equipped for 4-kv., 3-phase metering and the other for 2.4-kv., 2-phase metering similar to the arrangement in the field, except that lightning arresters were installed in the lower part of the cabinet in place of the cutouts. Load side and line side leads were brought into the bottom of the cabinets.

Impulse tests were made on each line wire with two types of surges. Each was applied successively from the service and from the load side of the equipment. The two types of surges represented 1½ 40-microsecond waves with crest voltages of 100 kv. and 240 kv. respectively. The peak current through the arresters was about 5,000 amp. Sixty-cycle power voltage of 2,300 volts was applied simultaneously with the surges. The purpose of these tests was to determine the effectiveness of the lightning arresters.

These were followed by a second group of surge tests with the lightning arresters disconnected. These started at 10 kv. and increased in steps of 5 kv. until breakdown of a piece of equipment, which was then disconnected and the tests continued on the remaining equipment until breakdown.

Relative Impulse Strength

A third group of tests was made on used and new potential and current transformers individually to determine their relative impulse strength. The following general conclusions were drawn from these tests.

1. The 3-kv. lightning arresters connected on the service side of the metering transformers provided adequate surge protection. This applied regardless of whether the surge originated on the service or load side.

2. Lead clearances within the cabinet were sufficient since the equipment itself failed without flashover to the cabinet.

3. The impulse strength of the primary cable to the cabinet was approximately 175 kv. or well above that of the individual pieces of equipment.

4. The impulse strength of the individual current and potential transformers ranged from 20 to 90 kv. Except for a few used transformers, none failed below the values published or estimated by the manufacturers.

The surge tests gave sufficient assurance that both old and new equipment could be effectively protected with lightning arresters placed in the cabinet; it was therefore decided to adopt this scheme. This meant transferring the cutouts to the crossarm on the terminal pole to provide space in the cabinet for the arresters. However, the need for more effective lightning protection offset the disadvantage of having to climb the pole to open the cutout.

Thus far lightning arresters have been installed in the primary cabinets at about 50 locations. These included existing installations where considerable trouble has occurred and new installations. During the past two lightning seasons (1944-1945) only

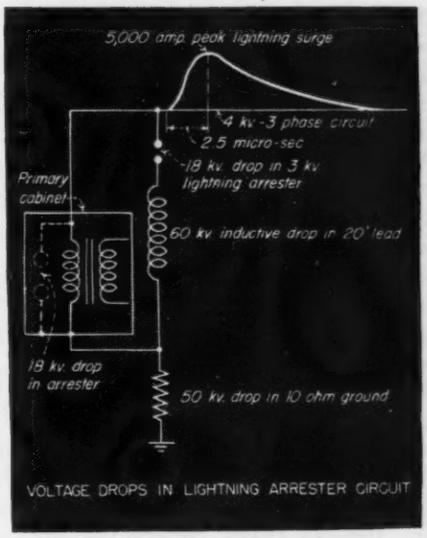

5,000 amp. peak lightning surge
4 kv.-3 phase circuit
2.5 micro-sec
18 kv. drop in 3 kv. lightning arrester
Primary cabinet
60 kv. inductive drop in 20' lead
18 kv. drop in arrester
50 kv. drop in 10 ohm ground
VOLTAGE DROPS IN LIGHTNING ARRESTER CIRCUIT

FIG. 3—Excessive surge voltages impressed on the metering equipment when lightning arresters were on pole are reduced to safe values when the arresters are located within the cabinets in place of the cutouts now put on crossarm

one case of trouble has occurred at these installations. This involved flashover of leads on a potential transformer under conditions of direct stroke severity. On the basis of six instrument transformers per cabinet, this single case of trouble in two years gives an approximate annual rate of trouble of 0.17 percent, as compared to about 1 percent before installation of arresters in the cabinet. This represents a reduction in trouble of about 80 percent. The performance thus far has been good and justifies extending this scheme of protection to other primary metering installations.

Mercury Arc Frequency Changer Limits Rolling Mill Demand

Rectifier-inverter installation at Gary Steel Mill ties 25-cycle mill generation to 60-cycle utility supply—Short sharp peaks controlled—Two-way transfers—Electronic regulator—Basis for d.c. transmission confirmed

R. W. HOLMAN, Electrical Engineer, Carnegie-Illinois Steel Corp., Gary (Ind.) Sheet & Tin Mill

EARLY IN 1943 Carnegie-Illinois Steel Corp. installed a 6,667-kw. mercury arc frequency changer at its Gary Sheet and Tin Mill to interchange power in either direction between the 25-cycle and 60-cycle power systems in the plant. The equipment, however, was purchased primarily for 60-cycle demand control that requires 25-to-60-cycle system power flow. The 25-cycle system is a large capacity system furnishing power to the United States Steel Corp. plants in the Chicago district. All 25-cycle power is generated in United States Steel Corp. plants, utilizing byproduct fuels, waste heat from various processes, and some purchased fuels such as coal, gas or oil.

The 60-cycle system is located at the Gary Sheet and Tin Mill plant and is furnished with power from the Northern Indiana Public Service Co. over 132-kv. lines to the plant where 60,000 kva. in three transformers reduces the 132,000 volts to 6,600 volts, the distributing voltage used on the underground distribution system throughout the plant. The 60-cycle system has connected to it such operating units as a hot strip mill, tin plate cold reduction mills, sheet cold reduction mills, temper mills, shear lines, electrolytic tinning lines, galvanizing and finishing departments, and many other miscellaneous loads.

Demand Is Crux

Preponderance of rolling mill load causes wide fluctuations in the plant electric power demand, which is metered and billed on a ½-hr. demand basis. From the beginning of the 60-cycle system in this plant (1936), a close control of power demand was necessary to effect the economic utilization of power under the power contract, because of the high value the contract places on the monthly maximum demand. If the rolling mills were allowed to use power without demand restrictions, the maximum monthly demand would reach about 17 to 20 percent over the normal controlled demand.

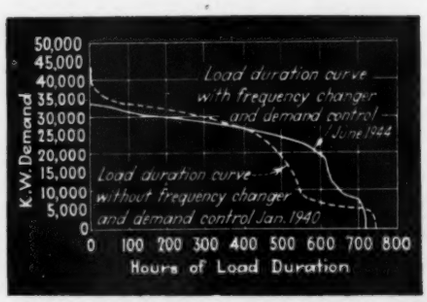


FIG. 1—Load duration curve on public utility lines serving steel mill. Former short-time demands levelled by mercury-arc frequency changer installed

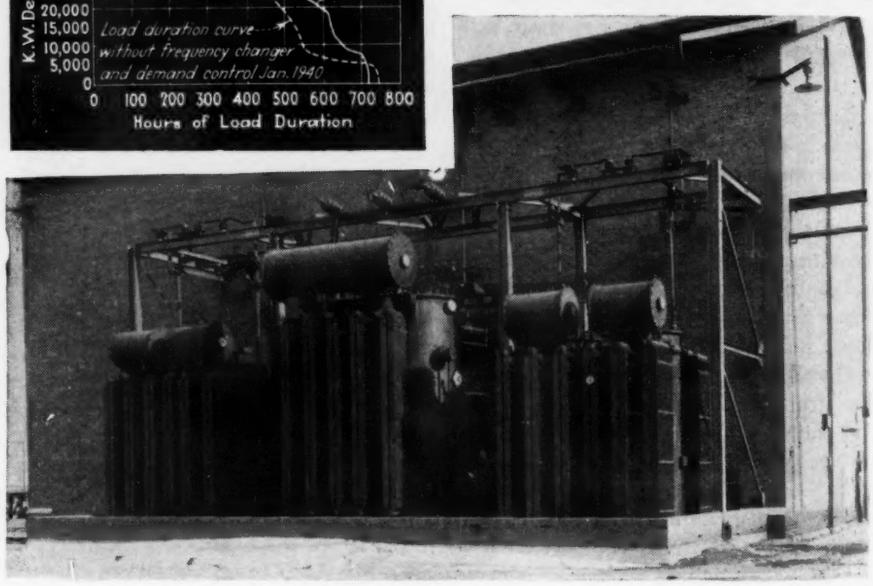


FIG. 2—25-cycle power enters frequency changer through this 8,220-kva. rectifier transformer. On each side of it there is a 7.5-millihenry reactor connected in the d.c. link

Thus the plant has two power systems serving it; namely the company-owned 25-cycle system where power is generated at low cost by utilization of unstorable byproduct fuels, and the 60-cycle system receiving its power from a public utility system. The latter cost per kilowatt-hour is somewhat higher because of the ½-hr. kw.-demand conditions and basic higher cost of public utility power generation from fuels purchased solely for this purpose. The problem was to install a conversion unit to utilize low cost power from the 25-cycle system in the 60-cycle system, to allow more economic usage of public utility power under the power contract, utilize available blast furnace gas and existing 25-cycle generating capacity, and to aid the 25-cycle system by 60- to 25-cycle power flow during inspection periods for the 25-cycle turbo generators.

Normally equipment to solve the above problem would be a frequency

changer of the synchronous-synchronous type to provide an interchange of power between the two systems. However, the 25-cycle system peculiarities ruled out this choice because of the frequency variations of ± 1.5 cycles or ± 6.0 percent, whereas the public utility system maintains frequency within a variation of ± 0.1 cycles on a 60-cycle basis or ± 0.166 percent. By virtue of the above frequency conditions it would be impossible to use a rigid synchronous-synchronous frequency changer of 6,667-kw. capacity as a tie between the two systems, each of which has over 200,000-kw. generating capacity.

Alternatives Rejected

There are several methods of accomplishing a controlled power interchange between these two systems, such as: The Scherbius system, two rotary converters, two ac.-dc. motor generator sets and the electronic mercury arc frequency changer. In evaluating these various methods, the following factors were considered: Efficiency, equipment and installation cost, power flow control, and maintenance cost.

The mercury arc frequency changer was chosen after comparing it with the above mentioned types of equipment. Advantages were the absence of large rotating parts, slip rings, commutators and brushes; low maintenance cost, no starting shock to the systems, ease of power flow control, inherent self-synchronizing features, light-duty foundations, low installation cost, and anticipated high efficiency (about 95 percent). The efficiency was known because the installation involved standard rectifier equipment for which the losses are known.

Disadvantages of the selected equipment were its higher first cost and the uncertainty of pioneering the first commercial mercury-arc frequency-changer installation purchased in this country. The performance, as power rectifiers, of the individual pieces of equipment involved was well known in advance of this installation, but their performance under the unusual power connections and grid control of the power inverter had to be determined by this first installation and available European experimental data.

At the time of this purchase, one other electrical manufacturer had been developing this type of equipment and had an experimental installation operating on their properties. Today, Carnegie-Illinois Steel Corp. has in operation the 6,667-kw. unit in the Chicago district and a 20,000-kw. unit in the Pittsburgh district. The 6,667-kw. rating was chosen because of the amount of power available for transfer, the size of equipment developed, and to make this first unit one-third of an eventual 20,000-kw. installation, if the availability of 25-cycle power and economies dictate at some future date the expansion of the installation at this particular location.

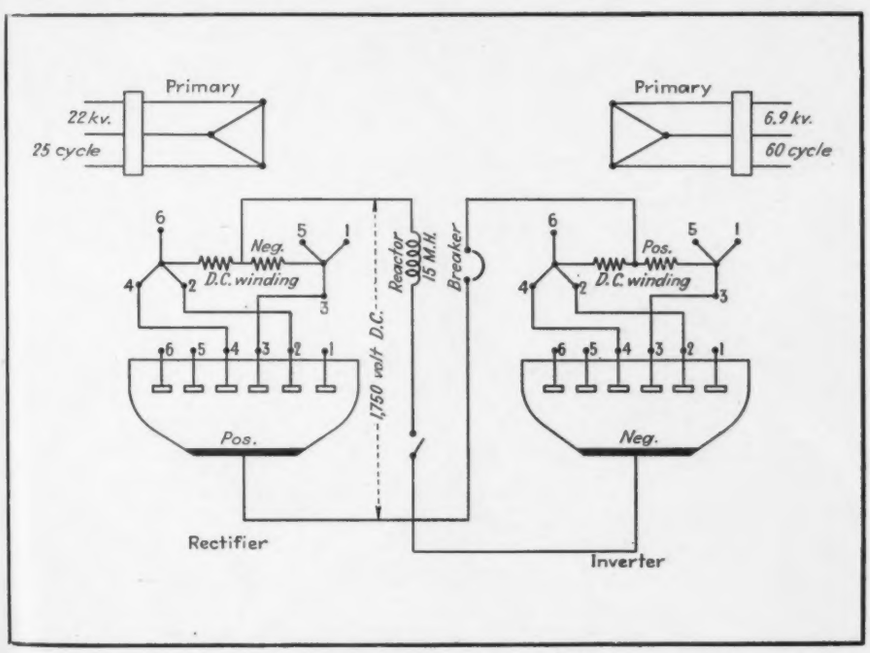


FIG. 3—One-half the frequency changer installation. The other 3,333-kva. unit is identical and connected to another double-wye secondary in the same transformer. For simplicity only six of the twelve anodes are shown; two anodes operate in parallel and are made to share the phase current equally by means of anode reactors

Load Duration

Hours of load duration on the public utility lines serving the plant for two months are shown in Fig. 1. Use of demand control and frequency changer manipulation have leveled the peak in the typical uncontrolled curve and permitted a better efficiency of utilization of demand and lower overall power cost. The right side of the chart is not considered comparable because of widely different levels of plant operation in the two months shown; also, the curves are typical of this plant only with its particular type of load and operating cycle due to product diversity.

The 80-in. hot strip mill consumes 40 percent of all 60-cycle power used in the plant and because of the wide range of thickness and width of the product rolled, its ½-hr. power demand fluctuates widely. The remaining plant load has a fair diversity factor, and thus it follows that the 80-in. hot strip mill is the primary cause of plant ½-hr. power demand fluctuations. On the other hand, the 80-in. hot strip mill is a versatile tool for controlling power demand because of the magnitude of the load, and because slab flow into the mill may be regulated to control plant demand. Short time stoppages or spacing of slabs does not affect the quality of the product.

Demand Control

Demand control is the responsibility of the power observer who actually controls the plant demand, and assumes dispatching duties only in those ½-hr. periods when the rate of power usage is in excess of the rate to reach the normal predicted or desired demand. The power observer accomplishes demand control on the public utility lines (1) by regulating the input from the 25-cycle system with the frequency changer, (2) by regulating the flow of steel slabs into the rolling mill, or in event the predicted demand is about to be surpassed, (3) by actually requesting a stoppage of slab flow or an immediate stoppage of cold reduction mill loads. These product-flow controls and stoppages are of such short duration and consume such a small

percentage of the ½-hr. demand periods of any month that they do not affect production to any great extent. As a matter of fact, one school of thought considers demand control an aid to production on a hot strip mill through a more uniform product flow; however, care must be exercised because too much curtailment by power demand control will result in a serious loss of production, and overshadow power bill savings.

The frequency changer is utilized in demand control by the power observer, who, when the mill schedule indicates orders requiring little power, reduces the power flow from the 25-cycle to 60-cycle system to some reasonably low value. When the mill schedule indicates a need for more power, the frequency changer is ordered to full load.

Base load control on the frequency changer is set manually at any value from 10 percent to 100 percent load and maintained there by regulators. Automatic peaking load control further affords a means whereby the output of the frequency changer is changed automatically from some pre-set light load to full load whenever the over-all rate of power usage in any ½-hr. demand period exceeds the predicted or desired rate of power usage; that is, the unit converts power at full load on peaking control only during those half hour periods or partial periods when the input is needed for demand control. The peaking feature is very applicable in periods where little power is available on the 25-cycle system.

D.C. Link Short

The 6,667-kw. mercury-arc frequency-changer is located in a 40- by 70-ft. brick building midway between a 66/22-kv., 25-cycle substation and a 132/6.6-kv., 60-cycle substation (Fig. 2) that are approximately 200 ft. apart. The choice of site insured short connections to each system and ample power capacity from the 60,000-kva., 60-cycle substation and the 60,000-kva., 25-cycle substation. Assuming a 25- to 60-cycle direction of power flow, the 22-kv., 25-cycle power enters the frequency changer site from the west (Fig. 3) through an oil switch and into a 8,220-kva. rectifier transformer, located outside the building, which in conjunction with two 12-anode rectifiers located inside the building converts the 22-kv., 25-cycle power to 1,750-volt d.c. power, and after passing through a 15-millihenry reactor is transmitted across the building where it enters the combination of two 12-anode inverters and an 8,340-kva. transformer, (Fig. 5), outside the east wall of the building through an oil switch and into the 6,600-volt, 60-cycle power system. In short, the various conversions are as follows: 22 kv., 25-cycle to 1,750 volts d.c., then 1,750 volts d.c. to 6,600 volts, 60-cycle. This d.c. link between the two systems provides a flexible tie; consequently, frequency variations and frequency ratio differences do not affect the power flow.

Voltage Regulated

Voltage variations, however, affect the power flow and rectifier voltage control regulators must be applied because the power flow is sensitive to voltage changes on both systems; thus, the problem of regulation is twice as difficult as on a single rectifier converting a.c. to d.c. power where only the voltage variations of one system must be smoothed out. Speed of correction is essential in a regulator for this equipment because many times both systems are simultaneously experiencing a voltage change in a direction that both systems will cause an increase or decrease in power flow. Several mechanical type regulators have been applied and found too slow, but the electronic and rotating machine type regulators have considerable advantage in this type of installation because of their increased speed and sensitivity and are being used at the present time.

The station is made up of two 3,333-kw. units entirely separate as far as

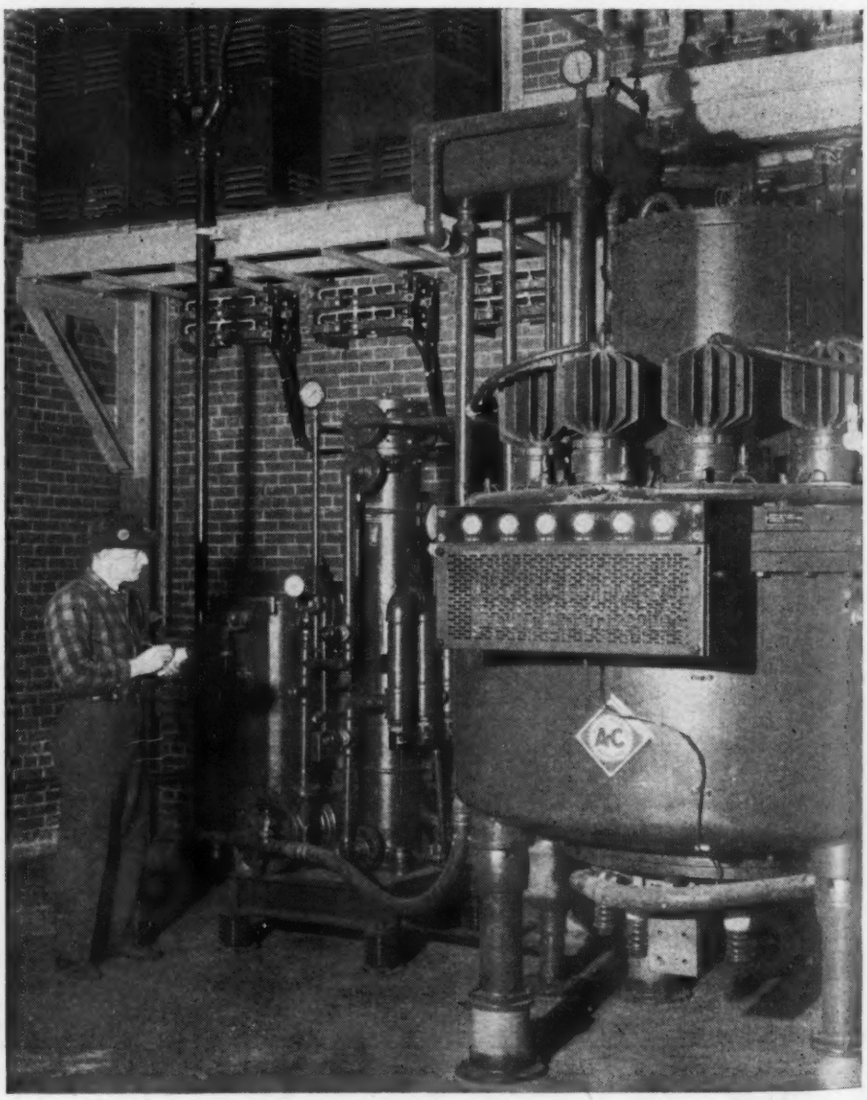


FIG. 4—One of the 3,333-kva. rectifiers with accessories. The preheating transformers shown in the upper left. Each rectifier and inverter has water-to-water heat exchanger

conversion and control equipment is concerned, but both units utilize one 25-cycle and one 60-cycle main transformer, each with double d.c. windings, one for each 3,333-kw. unit. The 25-cycle side is operated 6-phase with either one unit or both units operating. The 60-cycle side is operated 6-phase with one unit operating and 12-phase with two units operating. The choice of 12-phase operation on the 60-cycle side was made to reduce the interference effect of induced harmonic voltages to telephone communication because of the exposure between the public utility lines and the telephone circuits. The telephone company conducted tests in March, 1945, to determine the extent of telephone interference and it was found that harmonics were present in the output of the frequency changer but did not affect the public utility lines or cause any telephone interference.

Two-Way Flow

Either direction of power flow may be accommodated by the frequency changer by operating several double-throw control switches. The power output is controlled, after the initial directional set-up, by varying the d.c. output voltage of the rectifier resulting from changing the firing angle of the rectifier control grids. This control is accomplished by changing the bias voltage in the neutral of a grid control transformer secondary. Whenever the rectifier voltage (1,690) is very slightly above the counter e.m.f. of the inverter, little power flows between the two systems; however, as the rectifier voltage is raised, the power transfer between the systems increases and at 1,750 volts full load is reached. Thus, a rectifier voltage increase of approximately 3 percent changes the output from no load to full load. Output voltage of a rectifier is dependent upon the magnitude of its a.c. system voltage; therefore, a system voltage increase of 3 percent would also change the rectifier output from no load to full load in this instance. On power systems serving industrial consumers, voltage variations of 3 percent are frequent and common; therefore, this illustrates the speed and range required in the regulators to maintain constant power output for voltage changes on two systems.

Modified Patterns

Rectifier and inverter multi-anode tanks, (one shown in Fig. 4, with its heat exchanger) are identical in construction, with twelve anodes in a 6-ft. diameter tank with two energized grids for each anode. These are conventional 12-anode tanks with shields, grids, and grid control of a special design. They have the usual excitation anodes, starting anode, insulated cathode, cooling coil, and anode shields. The top grid is of the basket type, completely enclosing the anode, while the lower grid is of the plate type, located below the top grid in the anode shield and in both rectification and inversion the lower grid is fired a few degrees ahead of the upper grid.

Multi-anode inverter and rectifier tanks are continuously evacuated by a high-vacuum, mercury-vapor condensation pump and a motor-driven, vane-type, rotary low-vacuum pump. Water cooling jackets are installed on the anode plate, cooling dome, main tank, cathode plate and, in addition, the main tank is equipped with an internal cooling coil. Water cooling is effected on each rectifier or inverter tank by means of a separate water-to-water heat exchanger with a motor-driven pump circulating the water in the closed systems. Anode plate temperature is closely regulated by means of a modulating thermostat in conjunction with a motor-operated valve on the cooling water inlet to the heat exchanger. The water-to-water heat exchanger was chosen because mill water is pumped direct from Lake Michigan without filtering and carries with it silt and sand, which after a few months of operation would restrict the water flow through the cooling passages and cause uneven or improper cooling. Treated water is used in the closed systems.

Excitation and Grid

The "keep-alive" or excitation arc in each tank is provided through two excitation anodes and a single-phase power source with relays for automatic starting, supervising, and restriking of the excitation arc by means of a solenoid operated ignition rod.

Grid power supply for each rectifier and inverter is furnished from a separate auxiliary transformer in conjunction with electronic devices that provide peaked voltage waves to the grids. For the 25-cycle units, the primary of the grid power supply is connected to the 25-cycle system and for the 60-cycle units the grid power supply is connected to the 60-cycle system. This is a fundamental requirement for the proper operation of the rectifier and inverter and makes the frequency changer inherently self-synchronizing with the two power systems.

The circuit breaker in the 1,750-volt, d.c. link between the rectifier and

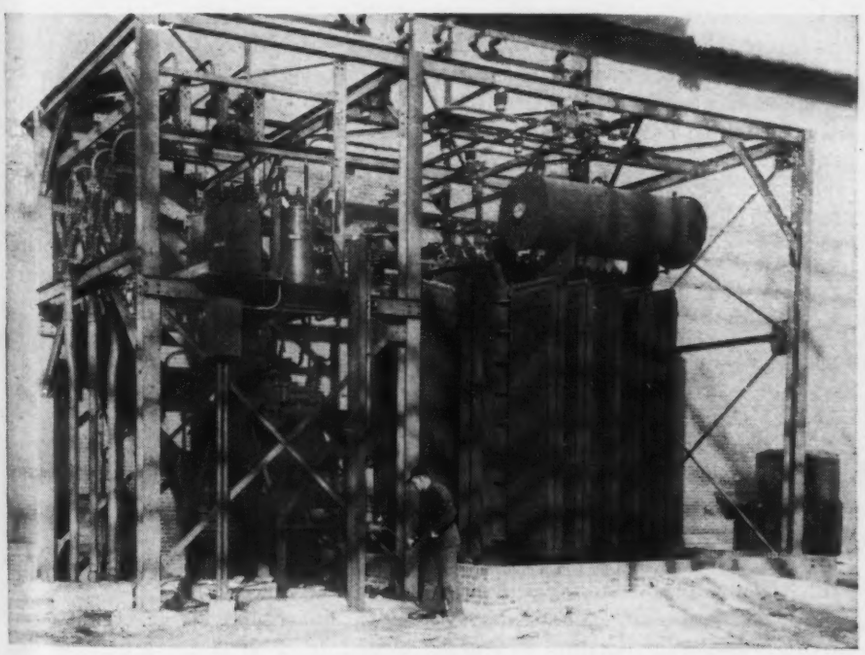


FIG. 5—8,340-kva. transformer associated with the two 3,333-kva. inverters and the 60-cycle oil switch on the 6,600-volt distribution system in the plant

inverter is unusual in that it is a conventional 6-pole rectifier anode breaker with the six poles connected in series. The initial impulse to open the circuit breaker actuates No. 1 pole which, when open, inserts current-limiting resistance in the circuit. The load current of the previous pole opening trips Nos. 2 and 3 in sequence, each of which inserts additional current limiting resistance. As No. 3 pole opens, the load current is allowed to flow in the trip coils of Nos. 4, 5 and 6 poles and they open simultaneously, breaking the circuit and extinguishing the arc. Each pole will open in one-half cycle; accordingly, the over-all breaker has approximately a 2-cycle opening time on a 60-cycle basis. Test oscillograms have shown the breaker to have a 2-cycle opening time plus slightly less than 1-cycle arcing time, which shows it to be an exceptionally high-speed breaker considering that it must open d.c. voltages as high as 4,500 volts and currents up to 10,000 amp. and, in addition, withstand the inductive kick of the large 15-millihenry reactor in the d.c. link. Although the normal circuit voltage is 1,750 volts, these over-voltages, as high as 4,500 volts, are caused by inverter arc-through that doubles the voltage duty plus the d.c. reactor voltage. The d.c. breaker will open on an inverter fault or arc-through without opening the a.c. line breakers and de-energizing the entire station. It is tripped by the current rate of rise in the d.c. link between the rectifier and inverter.

Inverter Trips Rare

Several types of internal faults can occur in a mercury-arc frequency-changer installation of this type. They are the arc-back as commonly experienced on rectifiers, and the arc-through or inverter fault. In this installation an occasional arc-back occurs, but they are almost wholly confined to the rectifier side of the equipment and are very uncommon on the inverter equipment.

The more frequent inverter fault or arc-through is the equivalent of a short circuit in the d.c. link and is caused by a failure of any inverter anode to deionize in a short time available after the firing period, or to block during the postive half of the cycle and fire early, or the failure of both anodes of any phase to pick up the load current from the previous phase in the firing sequence. In an inverter, the grid control and anode pick-up point and firing must be 100 percent accurate and reliable for every cycle 24 hours a day because a failure of any inverter anode for a single cycle means a short circuit on the system. In a 12-anode inverter tank there must be over five million perfect grid firing cycles every hour, otherwise a failure of a single grid for one cycle would result in an arc-through or inverter fault, whereas in a rectifier application any anode may fire early or not at all for several cycles and the result is unnoticed and little disturbance occurs in the output circuit.

Reactors in D.C. Link

The manufacturer recognized that grid control would probably not be perfect for five million grid firing cycles per hour in an inverter; consequently, protective measures have been taken to minimize the seriousness of these inverter faults by installation of reactors in the d.c. tie to prevent too steep a rate of rise of current in the first cycle of an arc-through so that current in the faulted anode does not reach too high a value and the grids have a chance to regain control before the next cycle. Other preventive measures are high speed grid blocking of the rectifier to reduce the current in the d.c. tie to zero for a few cycles to allow the faulted anode to regain control, and the d.c. breaker that opens the d.c. link in case the arc-through cannot be quenched by the above mentioned means.

In the early days of operation of the installation, outages or inverter faults were frequent; however, improved grid design, control improvements and additional reactance in the d.c. link has brought the outages down to about one in two weeks and the unit has operated on several occasions for a month without an outage due to an inverter fault. Although inverter faults or arc-throughs occur rather frequently, they are suppressed by the protective equipment without opening any of the circuit breakers.

Electronic Regulator and Auxiliaries

Five control cubicles are provided, four of which contain excitation, grid, vacuum, and temperature control equipment with one cubicle for each rectifier or the individual tanks. The fifth unit is the main control board and embodies the operating controls, meters, relays and control circuits, regulators, and protective devices.

Each rectifier is provided with a separate 130-kva. preheating transformer bank (Fig. 4) to preheat the anodes by passing 60 percent full load current through the anodes at low voltage before returning a unit to service following a prolonged shutdown. This preheating treatment, applied for about an hour, prevents arc-backs or arc-throughs which might occur on starting after long periods of idleness and cold rectifier internal parts.

Each 3,333-kw. frequency changer has a separate regulator designed to maintain constant power output. The regulator is of the electronic type that is highly sensitive and quick in response. On base load control the station output level is set by the operator. On peaking load control the maximum and minimum output is controlled by power demand regulating equipment that automatically changes the output from maximum to minimum and vice versa as dictated by the demand regulator.

Frequency-Changer Connections

It may be seen from Fig. 3 that the rectifier circuits are identical to those of the ordinary commercial rectifier and it may be assumed that the rectifier will deliver d.c. power at 1,750 volts in the amount required by the inverter. The positive terminal of the rectifier output is connected to the neutral of the d.c. winding of the 60-cycle inverter transformer and the negative terminal to the cathode of the 60-cycle inverter tank so that the direct current may flow through the individual phases of the d.c. winding and through the anodes and arcs to the negative cathode. The flow of direct current through these paths must be controlled or governed in such a way that its energy may be transferred and transformed into the 60-cycle system by the transformer. It is the function of the mercury-arc inverter tank to effect such control. The combined performance of the rectifier tank and the transformer is known as inversion.

The functioning of inversion is discussed in a separate article entitled "How the Inverter Transfers D. C. Power," on page 172 of this issue.

"Relight America"

FORTY years ago, when the Illuminating Engineering Society was started, we were able to secure with carbon filament lamps and gas mantles general illumination of the order of perhaps two or three footcandles of artificial lighting. That sounds pitifully small today, but considering the limited means then available it wasn't bad.

During the intervening years, as sources and equipments improved and as more knowledge was gained, our lighting attainment advanced at accelerating pace. This was impressed upon our several committees, who during the past two years have been reviewing all of our Recommended Practices for lighting different occupancies. What we thought was good lighting a decade ago is by today's standards wholly inadequate.

For similar reasons all pre-war lighting is out of date, and the same holds true for a large part of the war lighting. Though this continent may enjoy better lighting than all the rest of the world, judged by what we now know is obtainable, it is under-lighted. America needs relighting throughout.

The enthusiasm in the industry for a campaign to relight America stems not so much from the fact that we are able to provide more and better light and utilize it to better advantage than we could a decade ago, as it does from the fact that improved lighting can do so much good for the people of this continent.

On our streets, for instance, there were nearly thirty thousand traffic fatalities last year, two-thirds of which occurred at night. In other words, at a period when there was half as much traffic moving there were twice the fatalities! The answer is obvious, and we are hopeful that the cities of this country will not be long in accepting our new Recommended Practice for Street and Highway Lighting.

Our schools are constantly speeding up the tempo of instruction, in order to accommodate the ever-increasing knowledge the children must assimilate. There are no more hours so there must be quicker reception. Improved lighting, we feel, is one way to bring this about.

Caveat emptor may be a well accepted legal maxim, but it doesn't help the shopper very much. Better lighting, on the other hand, does.

Productivity of the worker, we hear on every hand, is the key to the riddle of how to pay higher wages without exacting offsetting price increases. If that be true, then improved lighting is absolutely essential in every factory. The report of our Light in War-Time Committee showed that no matter what was being made, improved lighting increased production, reduced spoilage, diminished accidents and generally contributed to better health and morale of the workers.

Compared to the public benefits, the cost of modern lighting engineered and installed in accordance with IES Recommended Practices, is picayunish. It isn't something that will take years to pay off. Rather we believe that the inadequate lighting of yesterday is costing the public each day vast sums, thousands of lives and quantities of much needed production—all of which could be saved by intelligent relighting.

Yes, America needs relighting.

To relight America is a tremendous job. It is the sum of all the jobs of relighting the places where the people of the nation live, move and have their beings. Each seller and installer of lighting must do his part. To each of these I commend the activities of the trade groups, most of whom base their recommendations upon the studied results of your Society's 25 technical committees.

A J Wakefield

President, Illuminating Engineering Society

WHERE TO SELL
Commercial and Industrial Lighting

BECAUSE the equipment and techniques for it have become available for it first, the first task in the self-imposed assignment of the lighting industry to "Relight America!" is the selling of modern lighting in commercial, industrial and related fields, in stores, shops, factories, offices, theatres, churches, etc., and on the public ways. This market is comprised of between 4 and 5 million places of business and other resorts, and of some 42,500 miles of highways and streets. It is the purpose here to indicate the proportions and characteristics of the many components of this diverse market in such terms that sellers and installers of modern lighting may be helped to determine the lighting business potentialities of the communities in which they operate.

The data presented here as indicative of the commercial and industrial market are all of pre-war origin, mostly 1939 and 1940 figures published by the Census Bureau. Although not exact as of today, these figures are still valid as indicators, particularly so when reduced to population relationships as has been done here. By applying these ratios to the local population figure, the seller of lighting can set bases for estimates of the market in this area.

Retail Establishments

For instance, it can not be said that the 1939 Census figure of 200,303 grocery stores is correct for today. But the figure of 637 people per grocery store may reasonably be used to calculate that a community of 25,000 population should have about 40 grocery stores. In like fashion and always, of course, with proper consideration of known local conditions, the components of the local market can be estimated, in "more or less" terms, it is true, but much better than no estimate at all. Knowing these components, and the kinds and methods of lighting to meet their requirements as disclosed on the pages following this discussion, selling efforts can be given specific directions and thus be more resultful.

The accompanying tabulation of retail establishments (Table 1) says there is a retail store of some kind or other for every 75 people in the country. In a community of 25,000 people, that means around 340 possible buyers of lighting as a profit maker. Largest single group of retail establishments is food stores, one to each 234 of population, over a hundred of them in a town of 25,000. Considering the many distinctive applications of lighting that can be made in food stores, this is a field well worth cultivating. The same town, according to the table, should have 50 or so filling stations, each one a prospect for attention-compelling outdoor lighting.

There are 35 kinds of stores listed in the table of retail establishments. This number does not by any means state all the different kinds of stores in the country. But the 35 listed are sufficient to give an idea of the diversity in this one segment of the lighting market and of its sales possibilities.

Service Establishments

In that community of 25,000, earlier instanced, there are about 125 service establishments of various kinds. Around 25 of them are barber shops, and 16 are beauty parlors, 14 are automotive repair shops, and 11 are shoe repair and shine shops. So says the tabulation of retail establishments in relation to population (Table 2). The four above-named constitute about one half of all the service establishments in any community and they make a nice bit of lighting sales business.

Additional to retail and service establishments, definitely classifiable as such, there is a third large segment of the commercial lighting market (Table 3). The table shows population relationships of the establishments listed, but use of these ratios in the determination of local markets may not in all instances be made so confidently as in the cases of occupancies listed in the first two tabulations. It is quite permissible for churches, schools, banks, theatres, billiard and pool parlors, and professional offices to be taken as fairly evenly distributed according to population, but other offices, hotels, wholesale trade establishments, public buildings, hospitals are likely to be found in larger numbers in large communities than in small. And certainly it may not be assumed, from the ratio figure of 1197, that a community of 25,000 can be expected to have 20 railroad stations.

Industrial Lighting Market

Probably the 1939 Census figures of manufacturing establishments are farther off from the conditions of today than are those of trade and service. However, the breakdown of the 1939 figures reveals circumstances that are not likely to have changed greatly and that can be used in appraisal of local markets for industrial lighting.

First is the fact that only a very few of the manufacturing establishments in this country are big enough to be dignified by the term "industrial plant." Most of them are just "factories" or "shops," when classified

TABLE 1. Retail Establishments

Occupancies	Number of Establishments	Population per Establishment
Grocery stores	200,303	657
Combination grocery and meat stores	187,034	704
Meat and fish markets	42,360	3,110
Fruit and vegetable markets	27,666	4,760
Dairy products stores	16,834	7,820
Candy, nut and confectionery stores	48,015	2,740
Other food stores	38,337	3,435
General merchandise stores, department stores included	57,381	2,295
Dry goods stores	15,628	8,420
Variety stores	16,946	7,770
Men's, boys' clothing, furnishings	21,501	6,120
Family clothing stores	10,053	13,100
Women's ready-to-wear stores	25,820	5,110
Accessories, other apparel stores	29,098	4,530
Shoe stores	20,487	6,420
Furniture stores	19,902	6,620
Other home furnishing stores	12,012	10,960
Household appliance, radio stores	20,913	6,310
New and used motor car dealers	41,607	3,165
Accessory, tire, battery dealers	18,525	7,120
Filling stations	241,858	545
Lumber, building materials dealers	25,067	5,250
Heating, plumbing, paint, electrical stores	14,600	9,030
Hardware stores	29,147	4,520
Farm implement dealers	10,499	12,530
Restaurants, cafeterias, lunchrooms	99,068	1,330
Lunch counters	70,724	1,862
Drinking places, with meals	82,310	1,600
Drinking places, without meals	53,284	2,470
Package liquor stores	19,136	6,880
Jewelry stores	14,559	9,040
Drug stores	57,903	2,275
Cigar stores and stands	18,504	7,120
Florists	16,055	8,100
Hay, grain and feed stores	16,772	7,860
Second hand stores	23,962	5,500
Other retail stores	99,148	1,328
Total retail stores	**1,770,355**	**75**

TABLE 2. Service Establishments

Occupancies	Number of Establishments	Population per Establishment
Barber shops (includes 4,199 combined barber and beauty shops and 1,600 bath and massage places)	123,797	1,064
Beauty parlors	83,071	1,585
Cleaning, dyeing, pressing shops	65,408	2,015
Hand laundries	15,245	8,570
Power laundries	6,773	19,400
Photographic studios	10,957	12,000
Shoe repair and shine shops	58,083	2,260
Business services	28,642	4,590
Automotive repair and service	72,067	1,830
Parking lots	6,274	21,000
Blacksmith shops	16,797	7,840
Radio and electrical repair shops	14,347	9,180
Watch, clock, jewelry repair shops	12,485	10,520
Printing shops	13,570	9,700
Custom service shops	52,283	2,520
Other service and repair shops	66,229	1,985
Total service establishments	**646,028**	**208**

TABLE 3. Other Commercial Establishments

Occupancies	Number of Establishments	Population per Establishment
Theatres*	15,346	8,600
Billiard and pool parlors*	12,998	10,100
Other amusement places*	16,573	7,950
Hotels	27,987	4,700
Churches	253,762	520
Hospitals (estimated)	8,000	16,500
Banks	15,146	8,700
Professional offices (estimated)	175,000	750
Other offices (estimated)	175,000	750
Schools (estimated)	275,000	480
Public buildings (estimated)	95,000	1,390
Railroad stations (estimated)	110,000	1,200
Wholesale trade establishments	200,573	640
Others unidentified	466,232	282
Total other establishments	**1,846,617**	**71**

*Except those operated by educational, religious, charitable, and fraternal institutions, by governmental and civic bodies, and by non-profit organizations.

TABLE 4. Food Products Establishments

Occupancies	Number of Establishments	Population per Establishment
Meat products	3,387	38,900
Dairy products	9,535	13,800
Canned foods	3,053	43,200
Grain mill products	3,746	35,100
Bakery products	18,399	7,150
Sugar, candy, related products	1,508	87,200
Miscellaneous food products	6,075	21,700
Beverages	5,745	22,900
Total food products	**51,448**	**2,560**

TABLE 5. Total Commercial and Industrial Sales Prospects

Kinds of Business	Number of Establishments	Population per Establishment
Retail establishments	1,770,355	75
Service establishments	646,028	208
Other commercial establishments	1,846,617	71
Manufacturing establishments	184,230	714
All establishments	**4,447,230**	**30**

according to numbers of employees. Of the total of 184,230 manufacturing establishments reported by the 1939 Census, 168,814 have 100 or less employees each, and of this number 84,245 each have five employees or fewer.

Second is the fact that of the 184,230 establishments reported, 51,448 are processors of food or kindred products, as appears in Table 4. Such establishments are more likely to be uniformly distributed among the population than are those of other manufacturing groups.

These two facts indicate that in other than definitely industrial communities the market for industrial lighting lies in quite small establishments of which many are processors of food. These conclusions say that the seller of lighting in the ordinary community, not highly industrialized, can still find a respectable market for industrial lighting if he will look for it.

All of these commercial and industrial establishments add up to a total of 4,447,230 prospects for the sale of lighting, one for every 30 of population (Table 5). This is to say that in that community of 25,000 the seller of lighting should be able to find around 800 prospects in the commercial and industrial fields. Possibly he won't find so many, possibly he'll find more, but, more or less, there is a real market for commercial and industrial lighting in every community in this nation.

Commercial
Fluorescent Lighting
SHIELDED LUMINOUS UNITS
Basic designs for individual and continuous row fluorescent lighting equipment, with lamps shielded with louvers, plastic or glass.
Sell these for lighting
AUTOMOBILE SALES ROOMS . . . BANKS . . . COMMERCIAL INTERIORS . . . DEPARTMENT STORES
DRAFTING ROOMS . . . LIBRARIES . . . MARKETS
OFFICES . . . RECEPTION ROOMS . . . RESTAURANTS
SCHOOLS . . . SPECIALTY STORES . . . THEATRES

The designs shown on this page are typical examples of commercial fluorescent lighting equipment. This type equipment is sold for lighting most commercial interiors, and represents a large percentage of the total flourescent lighting market.

Designs on this page show four 40 watt lamps in each individual unit, or in each four foot length of continuous row equipment. Location of lamps, type of reflectors, louvers, glass and plastic, govern the type of light distribution, so that varied lighting effects are obtainable, ranging from semi-direct to luminous indirect.

The same type of equipment can also be made for other standard fluorescent lamps, including the 100 watt and the new long slim lamps, commonly referred to as "slimline". Each manufacturer achieves individuality in design through variations in ornamentation, finish, mechanical construction, and combinations of metal and glass or plastic. Practically all of these units are designed for installation on the ceiling, or for suspension by means of metal stems.

Arrangement of lamps is not limited to those shown on this page. Other arrangements, in combination with metal reflectors or diffusing media are also available, designed specifically for predetermined light distribution, and for special lighting applications.

RELIGHT AMERICA

Directions for Use

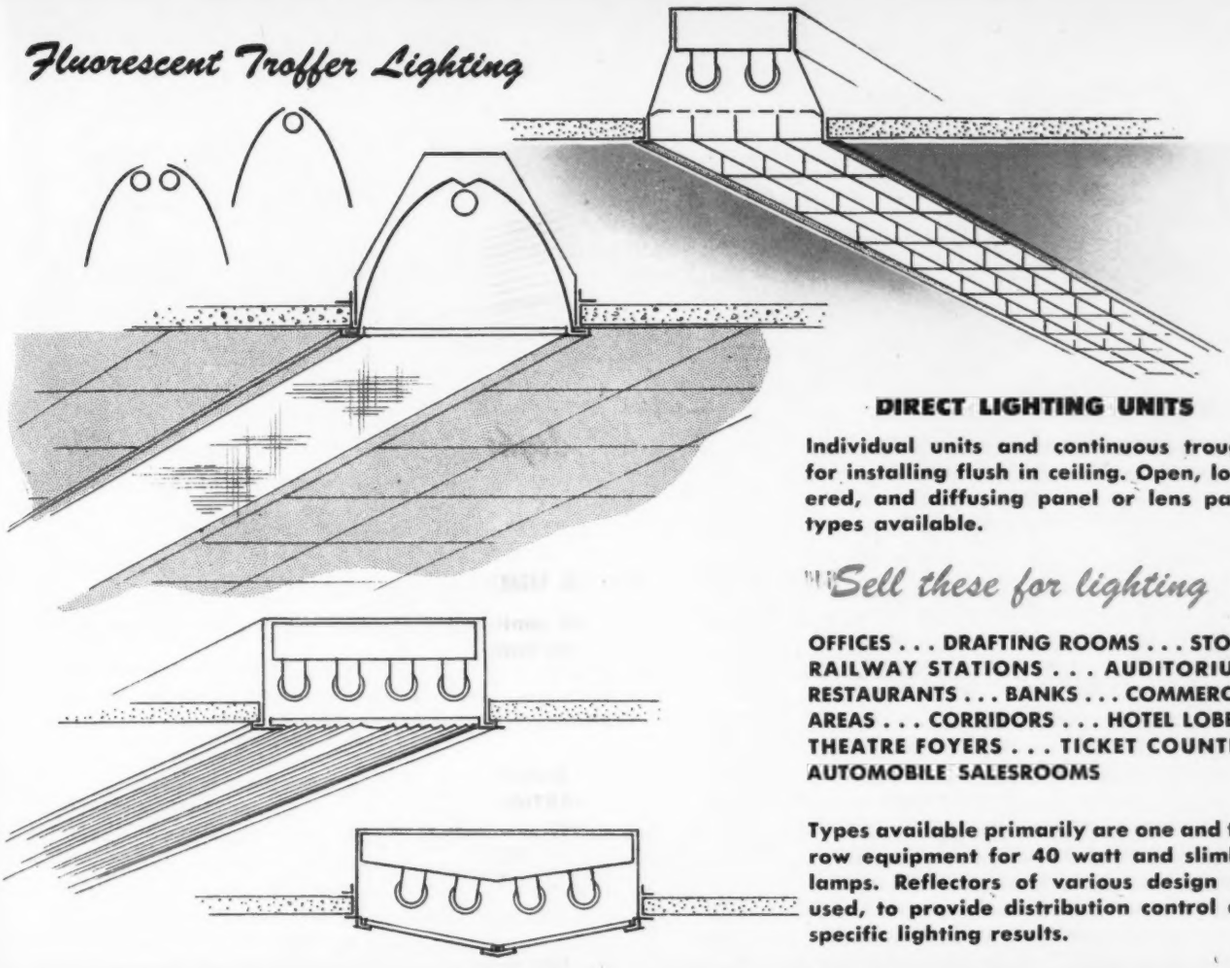
VERSATILITY is the outstanding characteristic of lighting equipment. Few, if any, of the many forms and types of lighting fixtures and methods are inherently limited to single applications and to those only. In practically every case a lighting means designed for a specific purpose may be used effectively for at least one other purpose, and probably for many. Therefore, the applications listed with the various forms of lighting illustrated and described on this and following pages are not to be regarded as in the nature of exclusive specifications but as suggestions and reminders.

Combining these suggestions with a statistical resolution of his local market, as outlined in the text and tables on the preceding two pages, should give to each seller of lighting a fair idea of what and how much he can sell in the commercial and industrial fields of his community.

Reasonably comprehensive coverage of the ways and methods of lighting, rather than description of fixtures and units, was aimed at in making this presentation. There will be found in designs offered by manufacturers many variants and adaptations of the ideas shown here. From these the specifier of equipment for a lighting installation must select what he thinks is best in the particular case. For this, the information given here will be helpful.

The excellent drawings that illustrate these pages are the work of Ted Mehrer, Designer and Illuminating Engineer, New York City.

Fluorescent Troffer Lighting



DIRECT LIGHTING UNITS

Individual units and continuous troughs for installing flush in ceiling. Open, louvered, and diffusing panel or lens panel types available.

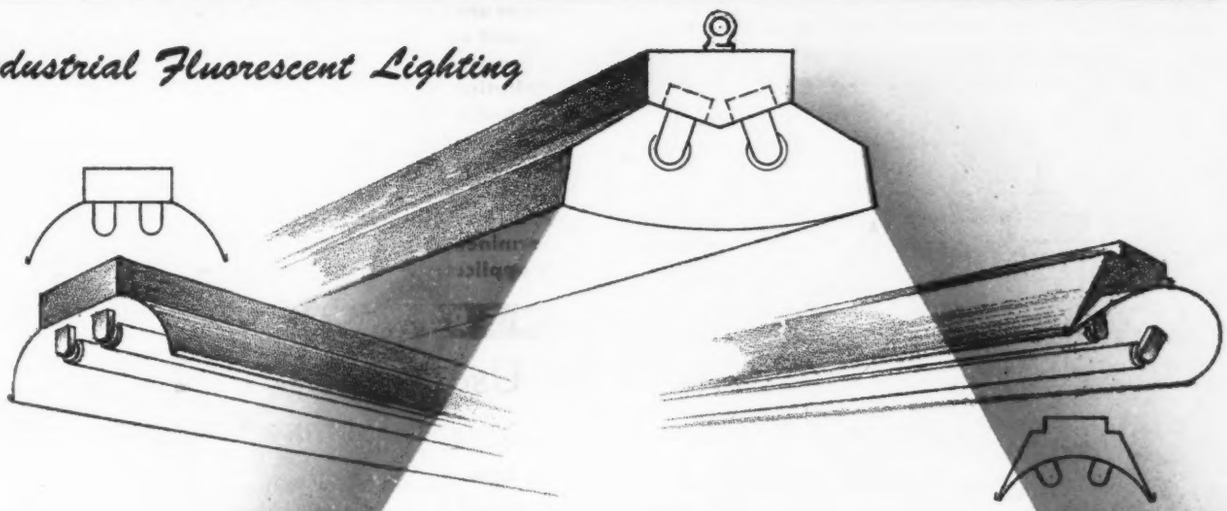
Sell these for lighting

OFFICES . . . DRAFTING ROOMS . . . STORES RAILWAY STATIONS . . . AUDITORIUMS RESTAURANTS . . . BANKS . . . COMMERCIAL AREAS . . . CORRIDORS . . . HOTEL LOBBIES THEATRE FOYERS . . . TICKET COUNTERS AUTOMOBILE SALESROOMS

Types available primarily are one and two row equipment for 40 watt and slimline lamps. Reflectors of various design are used, to provide distribution control and specific lighting results.

RELIGHT AMERICA

Industrial Fluorescent Lighting



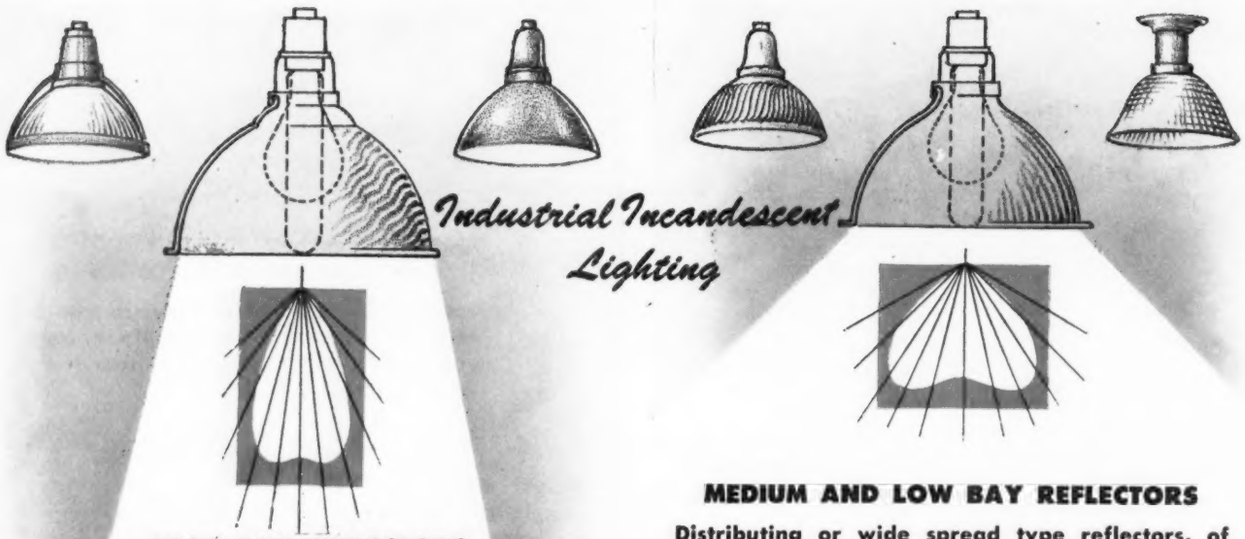
DIRECT LIGHTING UNITS

Reflectors shield lamps and control the light distribution.

Sell these for lighting

FACTORIES . . . FOUNDRIES . . . PRINTING PLANTS . . . MACHINE SHOPS . . . ASSEMBLING AREAS . . . LAUNDRIES . . . STORAGE AREAS . . . LOW BAY AREAS . . . MEDIUM BAY AREAS . . . MANUFACTURING AREAS . . . MISCELLANEOUS INDUSTRIAL AREAS

Available as individual units and for continuous row installation, for installing flush, on the ceiling, and suspended. Made for one or more lamps, and for all sizes of lamps, 15 watts and larger. Reflectors are available in porcelain enameled steel, baked enamel on steel, diffuse and specular aluminum, aluminum paint on steel, etc.



Industrial Incandescent Lighting

HIGH BAY REFLECTORS

Concentrating and semi-concentrating type reflectors of prismatic and silver mirrored glass, and of specular or semi-diffuse aluminum.

Sell these for lighting

STEEL MILLS . . . AUTOMOBILE PLANTS . . . AIRCRAFT FACTORIES . . . FOUNDRIES . . . ARMORIES . . . CONVENTION HALLS . . . HIGH BAY AREAS

Available for 500 to 2000 watt incandescent lamps and 400 watt mercury vapor lamps. 3000 watt mercury vapor units (not illustrated) also available.

MEDIUM AND LOW BAY REFLECTORS

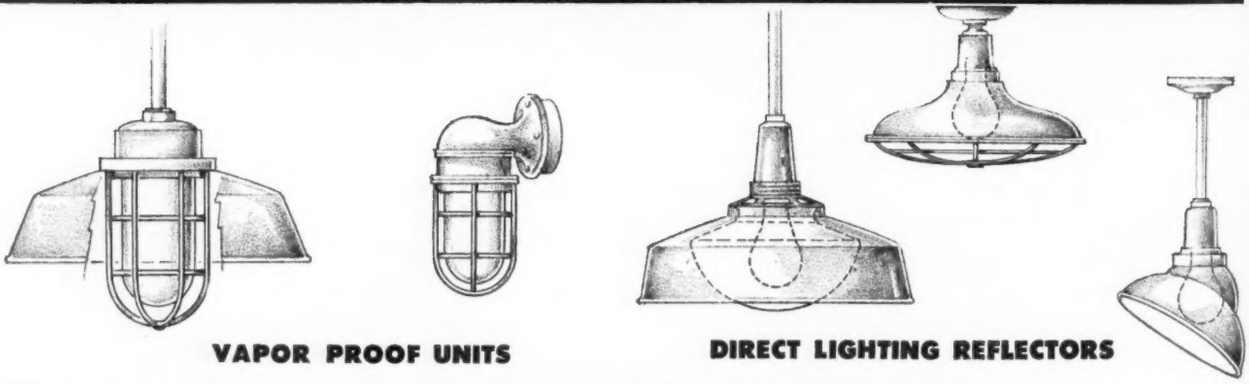
Distributing or wide spread type reflectors, of prismatic or silver mirrored glass, diffuse aluminum and porcelain enameled steel.

Sell this for lighting

ASSEMBLY AREAS . . . AIRCRAFT PLANTS . . . AUTOMOBILE PLANTS . . . MACHINE SHOPS . . . PRINTING PLANTS . . . RAILWAY STATIONS . . . LAUNDRIES MEDIUM BAY AREAS . . . LOW BAY AREAS . . . MANUFACTURING AREAS . . . TEXTILE MILLS . . . HOSIERY MILLS . . . WOOD WORKING PLANTS

Made in sizes for lamps of from 200 to 1500 watts, and for 250 or 400 watt mercury vapor lamps.

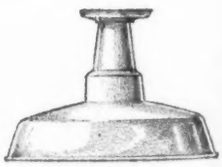
RELIGHT AMERICA



VAPOR PROOF UNITS

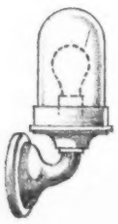
DIRECT LIGHTING REFLECTORS

Weatherproof and vaporproof * direct lighting type units for ceiling, pendant and wall mounting are shown at left. Reflectors at right shield the lamps and control the light distribution.



Sell these for lighting

AUTOMOBILE GREASE PITS . . . BOILER ROOMS . . . COLD STORAGE VAULTS DAMP LOCATIONS . . . DUSTY AREAS . . . EXTERIORS . . . FACTORIES GASOLINE SERVICE STATIONS . . . INDUSTRIAL AREAS . . . LOADING PLATFORMS . . . LOCALIZED WORK AREAS . . . LOCKER ROOMS . . . LOW BAY AREAS . . . MACHINE SHOPS . . . RAILWAY PLATFORMS . . . STEEL MILLS STOCK BINS . . . STORAGE AREAS . . . TRANSFORMERS . . . WORK BENCHES



Available for standard incandescent lamps ranging from 50 to 1500 watts, with reflectors of shallow, medium, deep and angle types. Fittings are furnished in a variety of types for different mountings.

*** Check National Electrical Code for classification of areas for hazard where vaporproof is permitted. Explosion proof type equipment is required for some areas in lieu of vaporproof.**

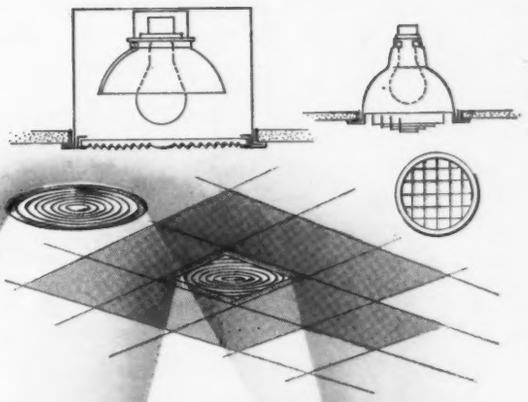
SHOW WINDOW REFLECTORS

Reflectors, ceiling flanges, louvers and color roundels are used for display lighting.

Sell these for lighting

SHOW WINDOWS . . . WALL CASES . . . FEATURE DISPLAYS . . . MURALS . . . ART OBJECTS

For use with 50 to1000 watt standard incandescent lamps, having concentrated, semi-concentrated and diffuse asymmetric light distribution. Available in prismatic and silver mirrored glass, with some types in aluminum.



DIRECT LIGHTING INCANDESCENT UNITS

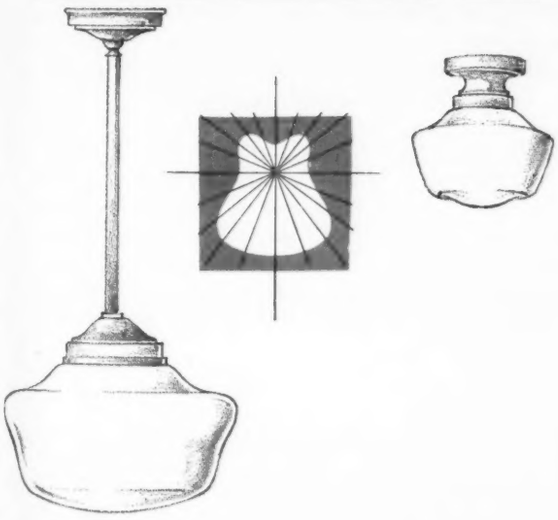
Individual incandescent units for recessed mounting in ceiling, lens and louver types.

Sell these for lighting

COMMERCIAL INTERIORS . . . SALES AREAS RESTAURANTS . . . RETAIL ESTABLISHMENTS COUNTER DISPLAYS . . . LOBBIES . . . SERVICE COUNTERS . . . CAFETERIAS

Provides general or specific direct lighting with 100 to 500 watt incandescent lamps, and shields lamps and reflectors from normal viewing angles. Lenses available round or square, and louvers of eggcrate, concentric, parallel or other types.

RELIGHT AMERICA



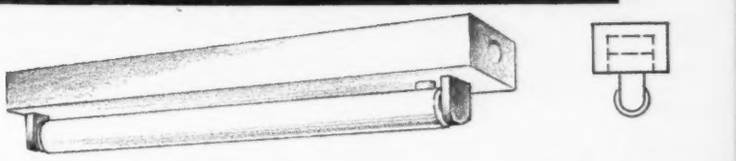
SEMI-DIRECT INCANDESCENT UNITS

Enclosing glass diffuses light from lamps, controls brightness and light distribution to some extent.

Sell these for lighting

RETAIL ESTABLISHMENTS . . . CORRIDORS . . . SERVICE AREAS . . . STORAGE . . . KITCHENS . . . PUBLIC TOILETS . . . BASEMENTS

Available in various shapes from ball globes to artistic designs, in diameters of eight to 20 inches.



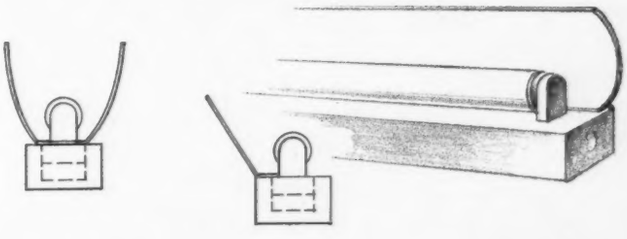
FLUORESCENT LIGHTING CHANNEL

Consists of wiring channel, lamp holders and bare lamp. May be used bare or with various type reflectors.

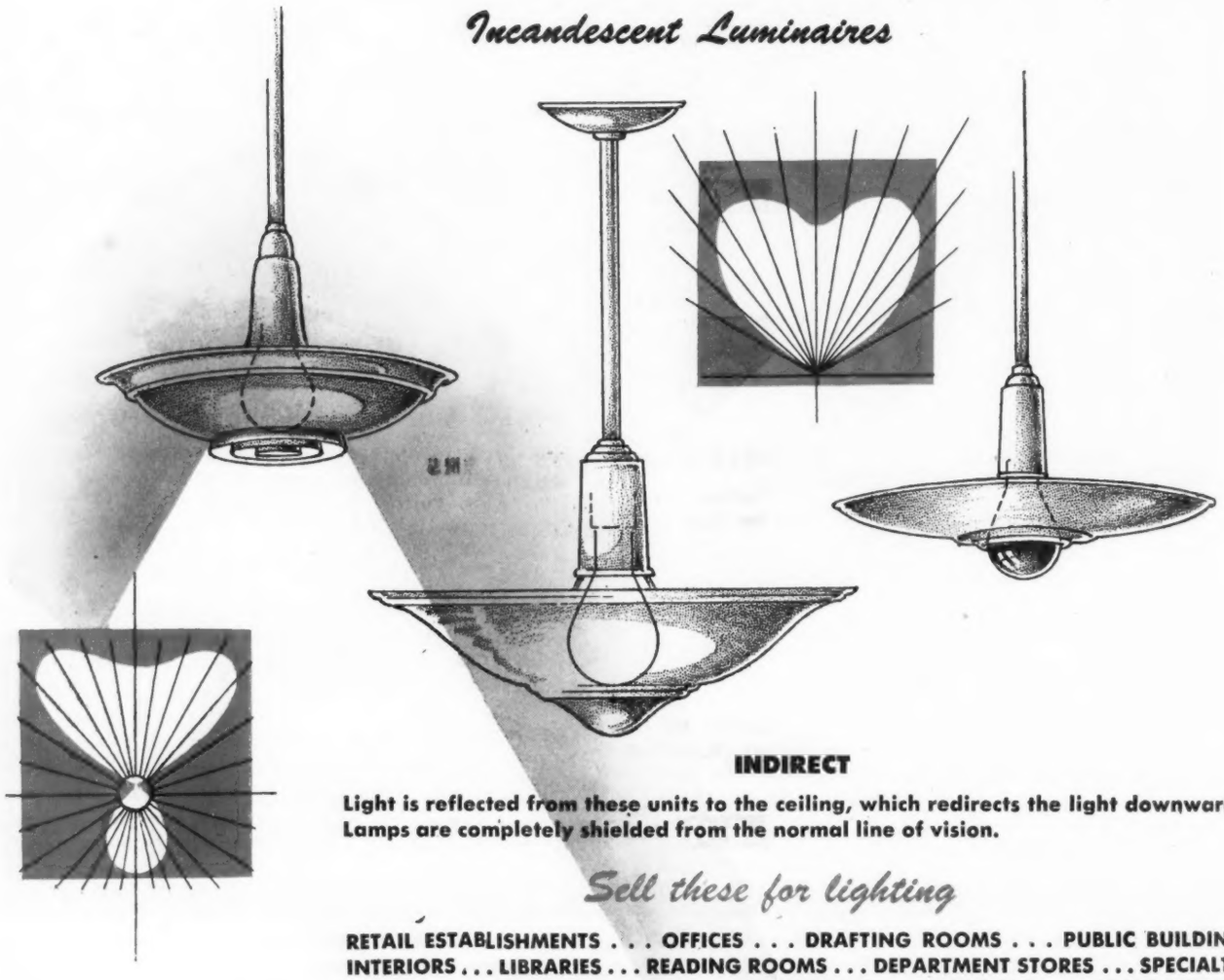
Sell these for lighting

CABINETS . . . WALL CASES . . . DISPLAY CASES IN COVES . . . IN DISPLAY NICHES . . . DECORATIONS IN SOFFITS . . . ARTIFICIAL SKYLIGHTS . . . ARCHITECTURAL ELEMENTS

Available for fluorescent lamps of 15, 20, 30, 40 and 100 watt sizes. May be used in individual units or continuous sections. Many uses can be found for this equipment, considered as a basic lighting component for special lighting applications.



Incandescent Luminaires



INDIRECT

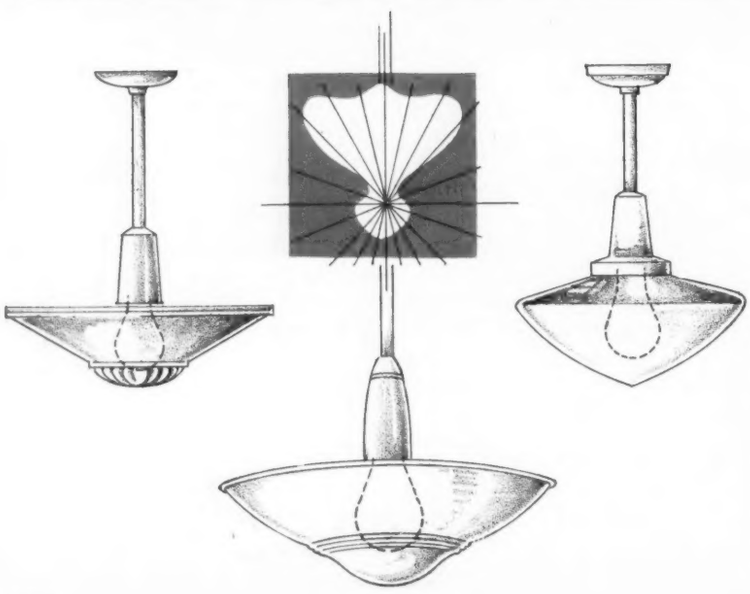
Light is reflected from these units to the ceiling, which redirects the light downward. Lamps are completely shielded from the normal line of vision.

Sell these for lighting

RETAIL ESTABLISHMENTS . . . OFFICES . . . DRAFTING ROOMS . . . PUBLIC BUILDING INTERIORS . . . LIBRARIES . . . READING ROOMS . . . DEPARTMENT STORES . . . SPECIALTY STORES . . . RESTAURANTS . . . AUDITORIUMS . . . SCHOOLS . . . CLASS ROOMS COMMERCIAL INTERIORS . . . BANKS . . . RECEPTION ROOMS . . . LOBBIES

Available with plain and ornamental type bowls for use with 200 to 1500 watt standard and bowl silvered lamps. Equipped with porcelain enameled steel, silver mirrored glass or aluminum reflectors. Bowls are of metal, glass, plastic or composition and, combined with plain or ornamental suspensions, are supplied in a variety of finishes.

RELIGHT AMERICA



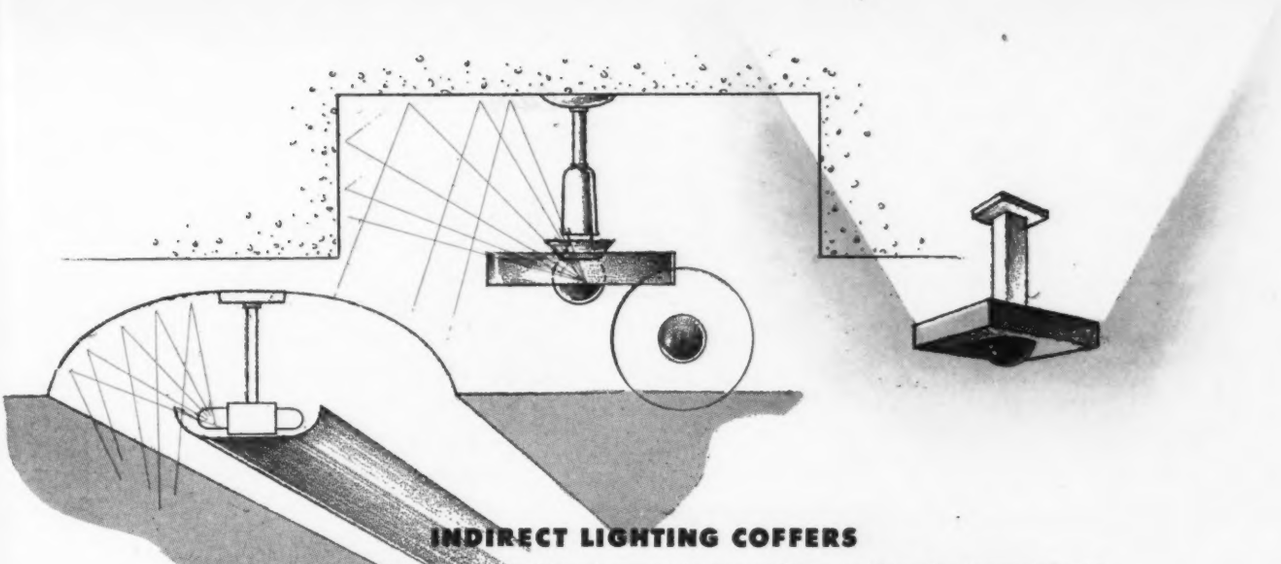
SEMI-INDIRECT

These units are similar to indirect luminaires, except that a small percentage of the light is transmitted through a diffusing medium.

Sell these for lighting—

AUDITORIUMS . . . CLASS ROOMS . . . COMMERCIAL INTERIORS . . . RETAIL ESTABLISHMENTS PUBLIC BUILDING INTERIORS . . . DRAFTING ROOMS . . . OFFICES . . . RESTAURANTS . . . LOBBIES

Bowls are made of plastic, glass, or a combination of metal and plastic, or of metal and glass. Sizes are available for standard lamps of from 200 to 1500 watts. Suspensions may be plain or ornamental.



INDIRECT LIGHTING COFFERS

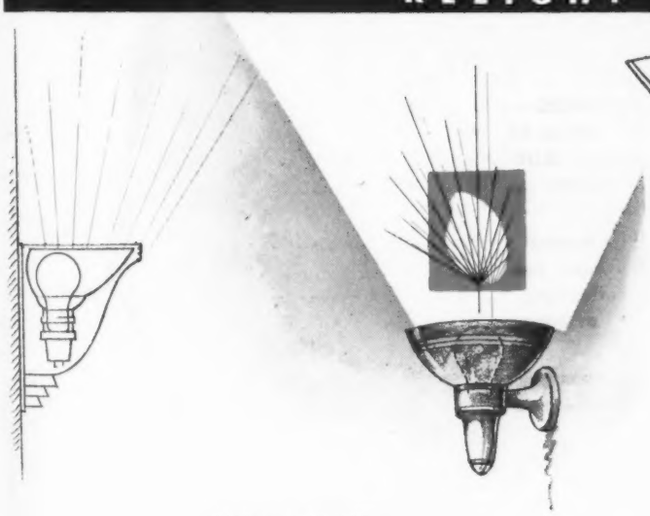
Lighting units are installed in coffers formed in the ceiling. Coffers for incandescent units are usually square, and for fluorescent troughs are usually continuous.

Sell these for lighting

BOARD ROOMS . . . BANKS . . . RECEPTION ROOMS . . . LOBBIES . . . DINING ROOMS OFFICES . . . STORES . . . LIBRARIES . . . DRAFTING ROOMS . . . PUBLIC BUILDING INTERIORS . . . NIGHT CLUBS

Provides well diffused illumination efficiently. Units may be designed to fit the architectural details, or architectural elements may be planned for standard equipment.

RELIGHT AMERICA



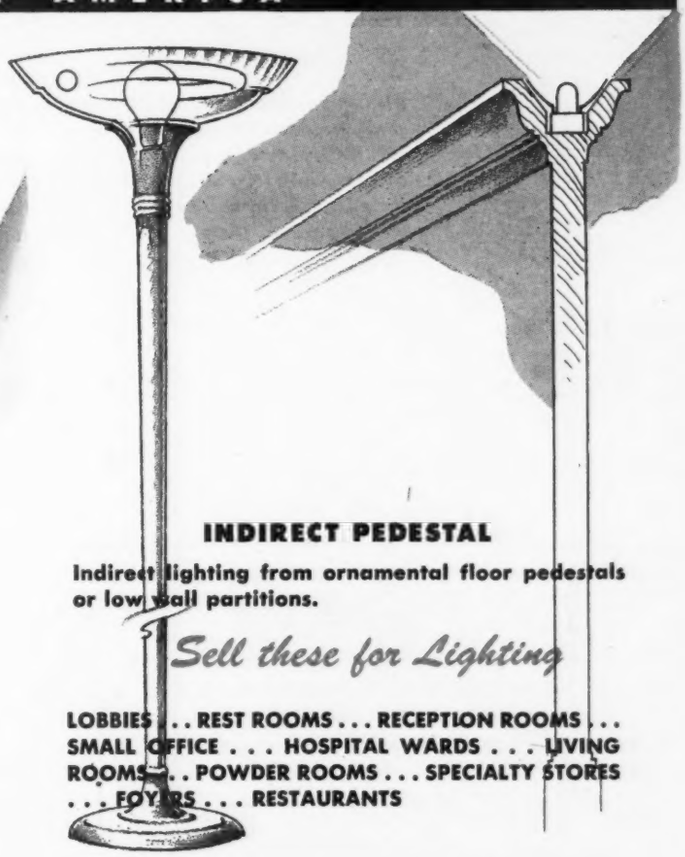
WALL URNS

Individual reflector units for incandescent lamps designed for wall mounting. Reflectors provide asymmetric light distribution to light ceiling uniformly and prevent undue brightness on wall above urn.

Sell these for lighting

RECEPTION ROOMS . . . LOBBIES . . . FOYERS PRIVATE OFFICES . . . REST ROOMS . . . NIGHT CLUBS TEA ROOMS . . . SPECIALTY STORES . . . LIBRARIES THEATRES

Plain and ornamental types are available for 200 to 1000 watt standard lamps. Silver mirrored glass and aluminum reflectors are housed in metal or combinations of metal, glass and plastic.



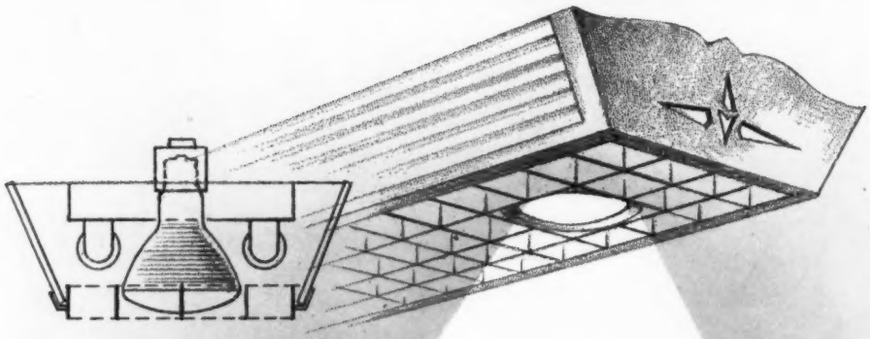
INDIRECT PEDESTAL

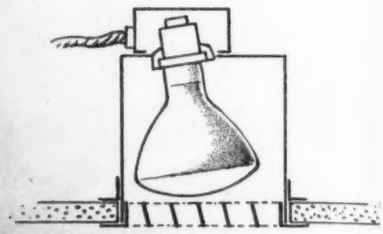
Indirect lighting from ornamental floor pedestals or low wall partitions.

Sell these for Lighting

LOBBIES . . . REST ROOMS . . . RECEPTION ROOMS . . . SMALL OFFICE . . . HOSPITAL WARDS . . . LIVING ROOMS . . . POWDER ROOMS . . . SPECIALTY STORES . . . FOYERS . . . RESTAURANTS

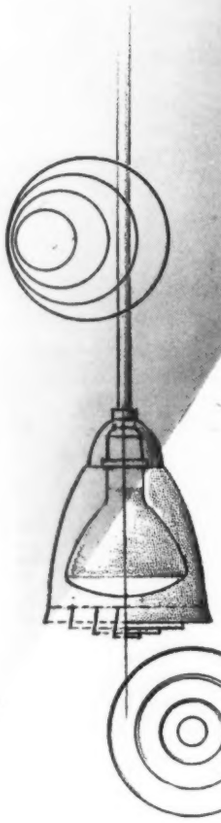
Provides well diffused illumination free from glare. Pedestal may combine incandescent lamp and fluorescent circular lamp, with separate switch control. Either fluorescent or incandescent lamps may be used in wall partition.





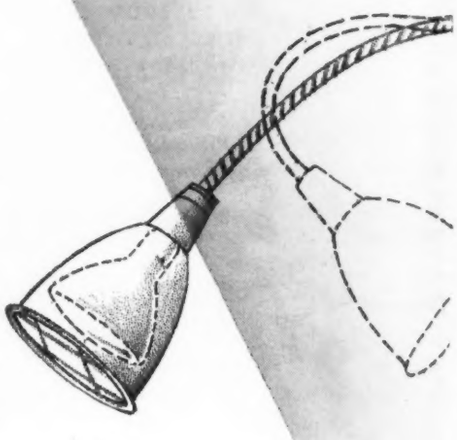
REFLECTOR LAMPS

Spot and Flood reflector lamps can be used for many special lighting applications. Accessories, such as color hoods, louvers, swivel bases, flexible arms, and universal swivel mounting rings broaden and refine these applications.



Sell these for lighting

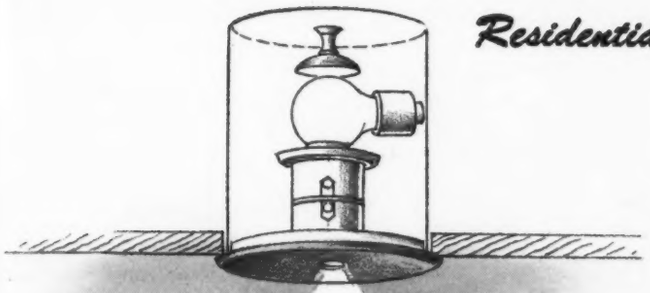
FEATURE DISPLAYS . . . SHOW WINDOWS . . . INTERIOR MODELS . . . SALES FEATURES . . . BILLBOARDS COUNTER DISPLAYS . . . AUTOMOBILES . . . WORK AREAS . . . INDUSTRIAL MACHINES . . . SPEAKER'S STANDS



These lamps, commonly referred to as R-40 reflector *spot*, or reflector *flood* lamps, combined with the many accessories, are considered as basic lighting components. Only a few typical accessories and applications are shown on this page. Their flexibility and use in obtaining unusual lighting effects, both in white lighting and in color, is limited only by the ingenuity and imagination of the lighting engineer. They are available in 150 watt and 300 watt sizes.

RELIGHT AMERICA

Residential Lighting



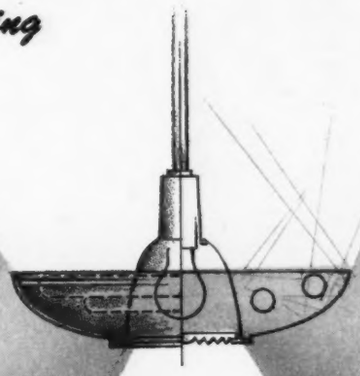
PIN HOLE SPOT

Produces an accurately controlled beam of light, which may be shaped in any desired pattern.

Sell these for lighting

THE DINING ROOM TABLE

Recessed flush in the ceiling over the center of the dining room table, a beam of light can be made to accurately frame the table, regardless of shape, so that the table is highlighted while no direct light reaches the diners.



DINING ROOM FIXTURE

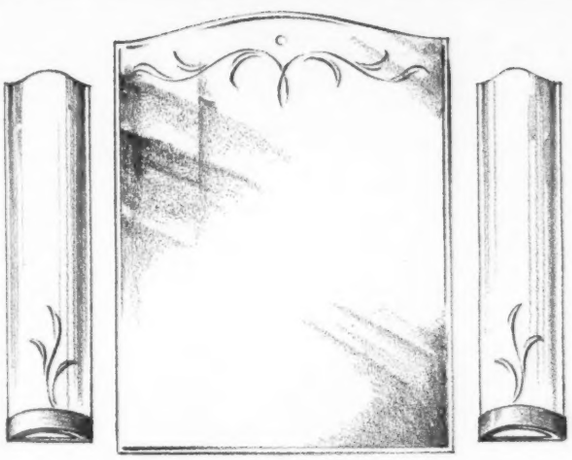
A combination two-circuit fixture designed specifically for lighting the dining room.

Sell these for lighting

DINING ROOMS

General illumination floods the room from circline lamps placed above the luminous plastic or glass bowl. Direct illumination for lighting the table comes from the incandescent lamp concealed in the reflector, producing direct lighting only. Fixture is wired so that each lighting effect is controlled by a separate switch.

RELIGHT AMERICA



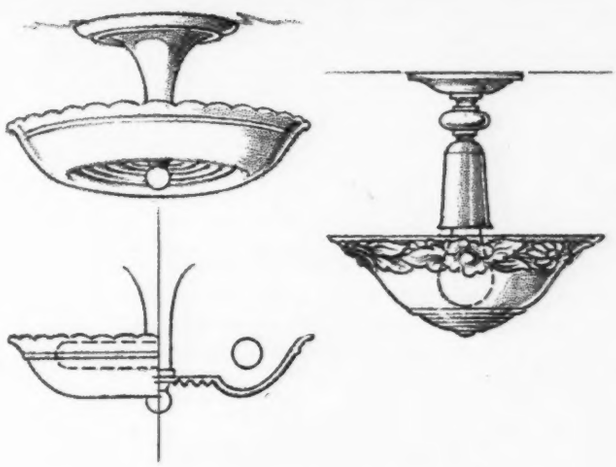
MIRROR LIGHTING

Low brightness long light sources, one on each side of mirror, for shadowless and non-glaring lighting.

Sell these for lighting

BATH ROOM MIRRORS . . . REST ROOM MIRRORS LADIES' LOUNGE MIRRORS . . . LAVATORIES

Tubular incandescent or small fluorescent lamps, concealed behind glass or plastic shields, provides a uniformly illuminated diffuser, which is non-glaring. The long light source prevents shadows on the face and provides uniform lighting.



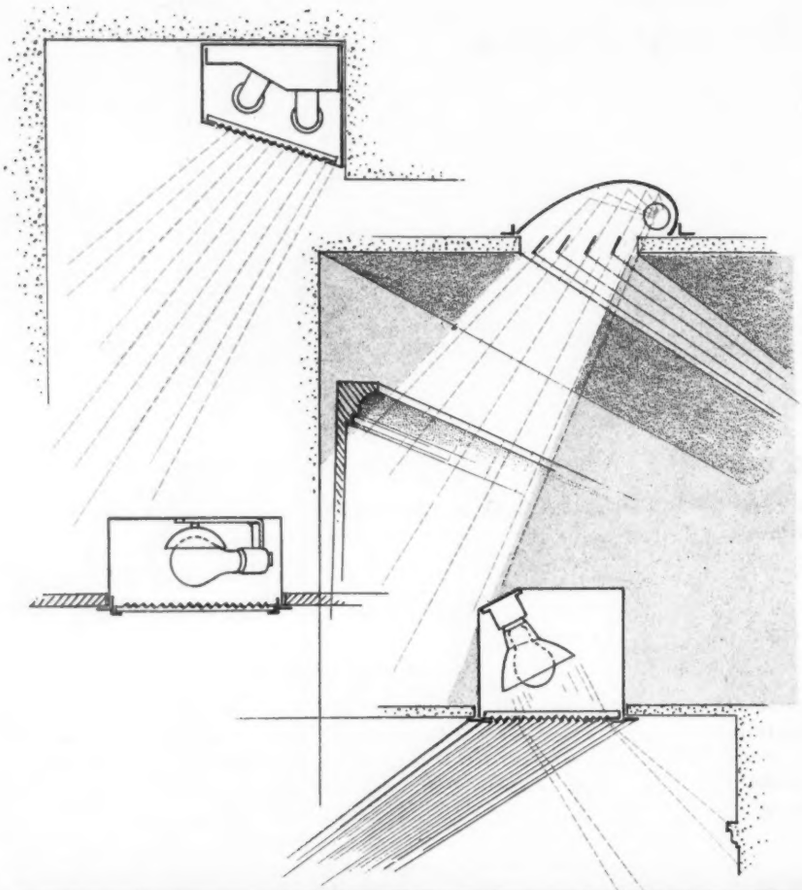
BEDROOM FIXTURES

Semi-indirect and indirect ceiling pendant units designed to produce uniform general illumination.

Sell these for lighting

BED ROOMS . . . FOYERS . . . HALLWAYS . . . REST ROOMS . . . DRESSING ROOMS

These ceiling units utilize glass or plastic for bowls, which serve as reflectors, and as shields for the lamps. Incandescent lamps up to 150 watts, or circular fluorescent lamps may be used as the light source in these units.



MURAL LIGHTING

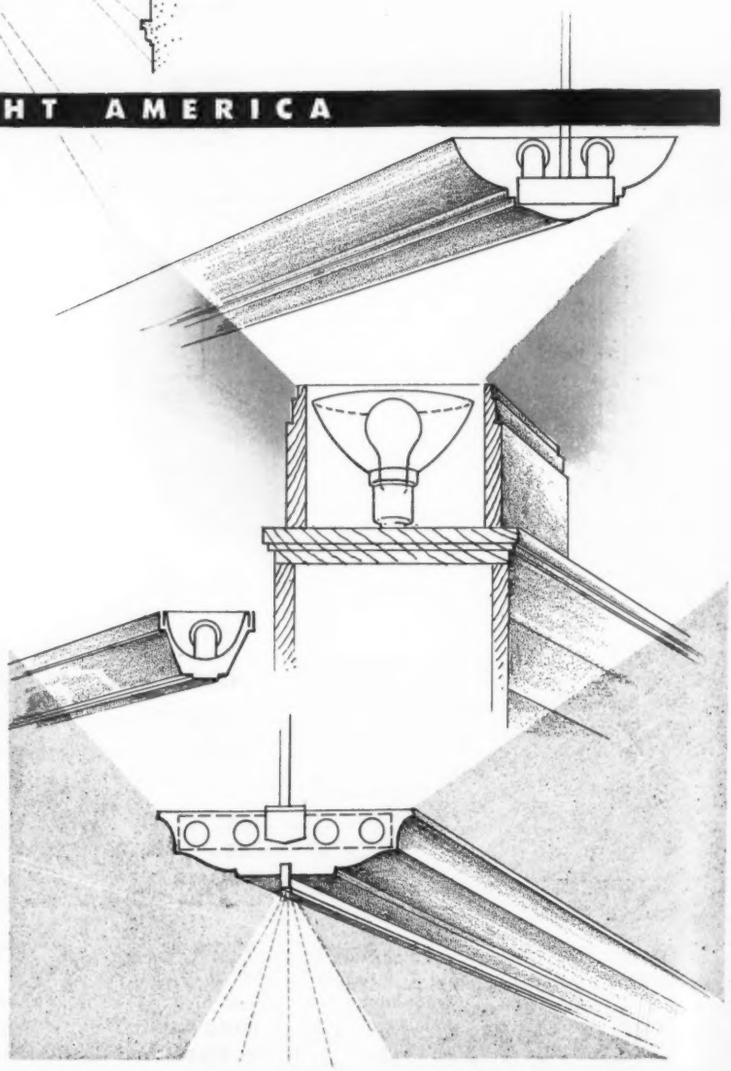
Asymmetric light distribution for uniform illumination intensity over large vertical surfaces.

Sell these for lighting

MURALS . . . THEATRE LOBBIES . . . WALL DISPLAYS . . . RESTAURANTS . . . ART MUSEUMS . . . WAR MEMORIALS . . . INTERIOR SIGNS . . . BLACKBOARDS IN CLASS ROOMS

Light sources are completely shielded, and light is directed toward wall area, away from the observer. This type equipment can also be installed flush in the wall with light distribution directed to ceiling for indirect lighting effects.

RELIGHT AMERICA



INDIRECT FLUORESCENT LIGHTING

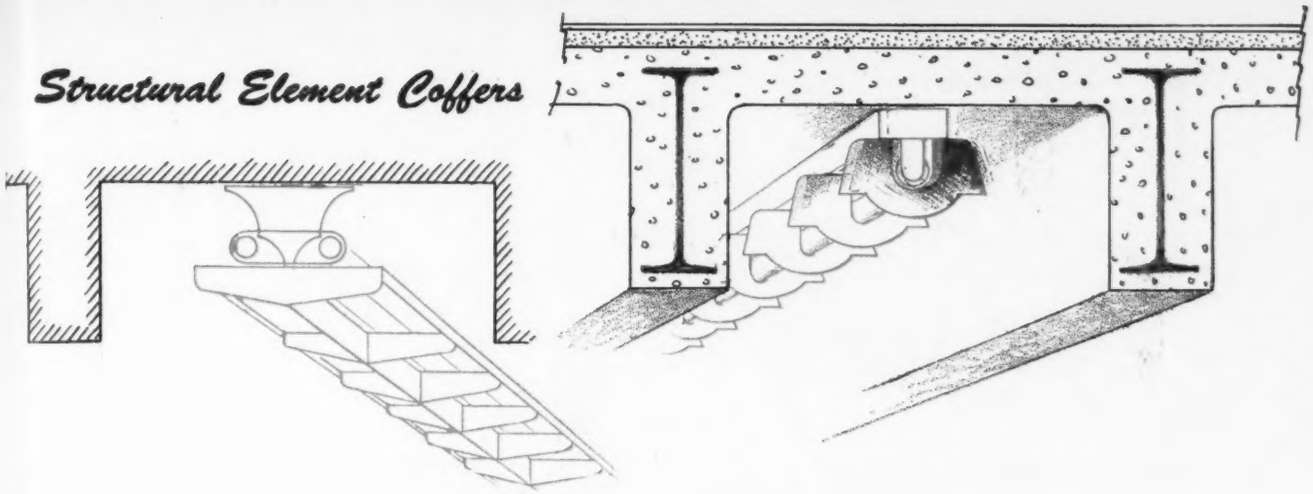
Soft comfortable lighting from concealed light sources, using standard indirect lighting troughs or lighting components in architectural elements.

Sell these for lighting

SCHOOLS . . . CLASS ROOMS . . . CHURCHES AUDITORIUMS . . . OFFICES . . . DRAFTING ROOMS . . . BANKS . . . PUBLIC INTERIOR AREAS . . . STORES . . . LOBBIES . . . RECEPTION ROOMS

High lumens per watt from fluorescent light sources make fluorescent ideal for indirect lighting. The size and shape of fluorescent tubes are well suited for adaptation to architectural elements.

Structural Element Coffers



SHIELDED DIRECT LIGHTING

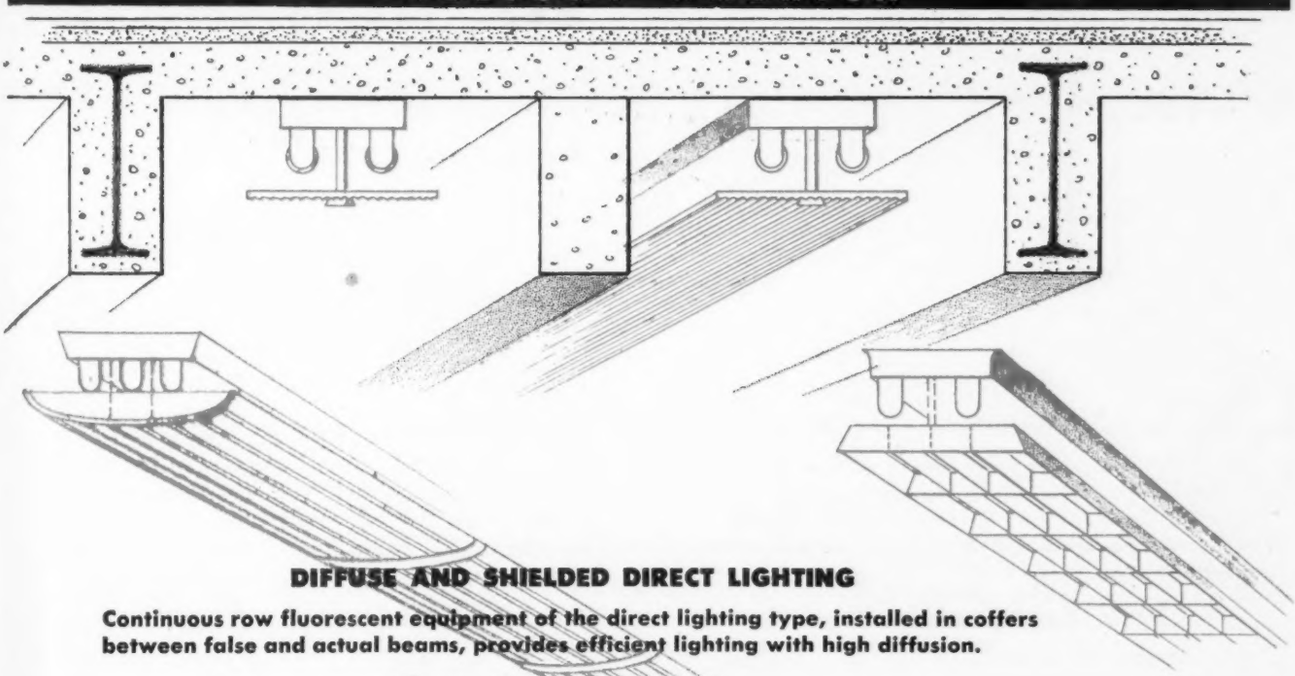
Coffers formed by structural beams form ideal lighting troughs for single-lamp or two-lamp continuous fluorescent lighting equipment.

Sell this for lighting

COMMERCIAL AREAS . . . FOOD MARKETS . . . OFFICES . . . INDUSTRIAL PLANTS . . . CONVENTION HALLS . . . BOWLING ALLEYS . . . DISPLAY ROOMS

Single row 40 watt or 100 watt fluorescent lamps, and single or double row slimline lamps, equipped with louvers for shielding the lamps from view in the normal line of vision, provide ideal equipment for installation in troffers formed by structural beams. Beams form the necessary shielding normal to the lamps, and cross louvers shield the lamps along their length. Width of troffer should not exceed twice its depth, for proper shielding.

RELIGHT AMERICA



DIFFUSE AND SHIELDED DIRECT LIGHTING

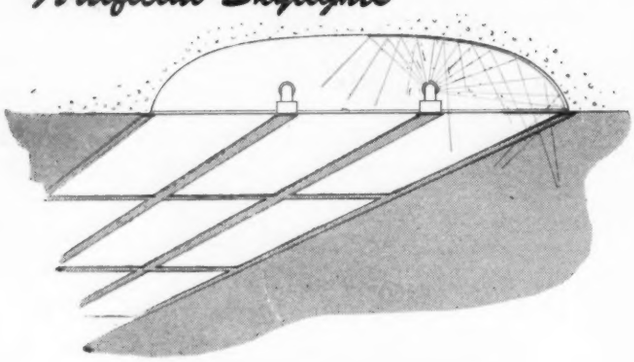
Continuous row fluorescent equipment of the direct lighting type, installed in coffers between false and actual beams, provides efficient lighting with high diffusion.

Sell these for lighting

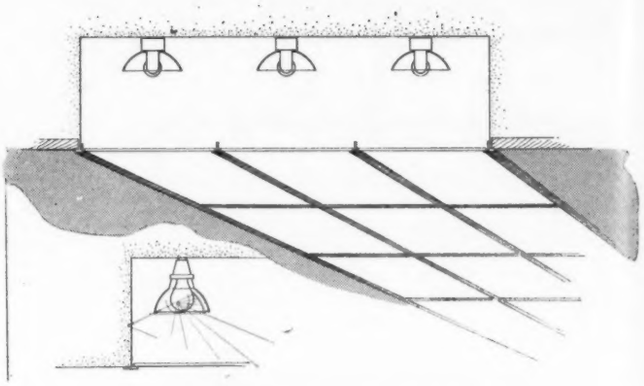
AUTOMOBILE SALES ROOMS . . . BANKS . . . COMMERCIAL AREAS . . . DRAFTING ROOMS DEPARTMENT STORES . . . DISPLAY ROOMS . . . OFFICES . . . STORES . . . INSPECTION AREAS . . . INDUSTRIAL PLANTS

Coffers are formed by natural beam construction and applied false beams. They are painted flat white to provide a high reflection factor. Beams shield the equipment normal to the troffer, and diffusing glass or cross louvers shield the lamps along the troffer. The lighted troffer surrounding the direct lighting type equipment reduces brightness contrast and provides an ideal lighting result, high in efficiency.

Artificial Skylights



INDIRECT LIGHTED PANELS



DIRECT LIGHTED PANELS

Large area, low surface brightness diffusing panels of glass, plastic or other diffusing media, are installed flush in ceiling, walls or columns. Light sources and reflecting equipment are installed behind the diffusing panels, properly spaced to provide uniform brightness on the panels.

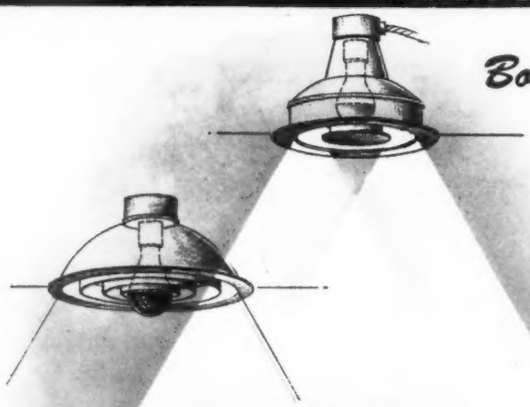
Sell these for lighting

AUDITORIUMS . . . AUTOMOBILE SALES ROOMS ART GALLERIES . . . BANKS . . . BANQUET ROOMS BOWLING ALLEYS . . . CORRIDORS . . . CLASS ROOMS COMMERCIAL AREAS . . . COURT ROOMS . . . DRAFTING ROOMS . . . FOYERS . . . FURNITURE STORES INSPECTION AREAS . . . LOBBIES . . . OFFICES PRIVATE OFFICES . . . PUBLIC BUILDINGS . . . RECEPTION ROOMS . . . RESTAURANTS . . . RETAIL ESTABLISHMENTS . . . STORES . . . THEATRES . . . WAITING ROOMS

This system of lighting provides well diffused illumination, with color quality of light controllable through change of light sources and careful selection of diffusing medium. Area of panels may be large or small, and may be controlled as to shape and pattern, to harmonize with architectural treatment. Fluorescent or incandescent light sources may be used. Spacing of light sources should be selected which will provide uniform illumination on the diffusing panels, and present an evenly illuminated appearance.

RELIGHT AMERICA

Bowl Silvered Lamp Reflectors



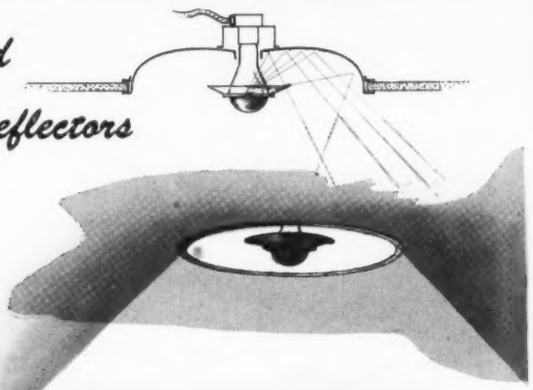
LOUVERED REFLECTORS

Bowl silvered lamps used with semi-distributing or concentrating type reflectors, louvered to prevent view of luminous part of lamp, produce a medium or concentrated beam of light with very little brightness at units.

Sell these for lighting

RESTAURANTS . . . LOBBIES . . . FOYERS . . . SPECIALTY STORES . . . WAITING ROOMS . . . RECEPTION ROOMS INFORMATION DESKS

Recessed flush in ceiling, these typical "down" lights are inconspicuous either lighted or unlighted. They can be used to subtly highlight a local area in a softly illuminated interior without accentuating the source of the light. Lighting salesmen and engineers can find many uses for these units, for lamps from 200 watts to 1000 watts in size.



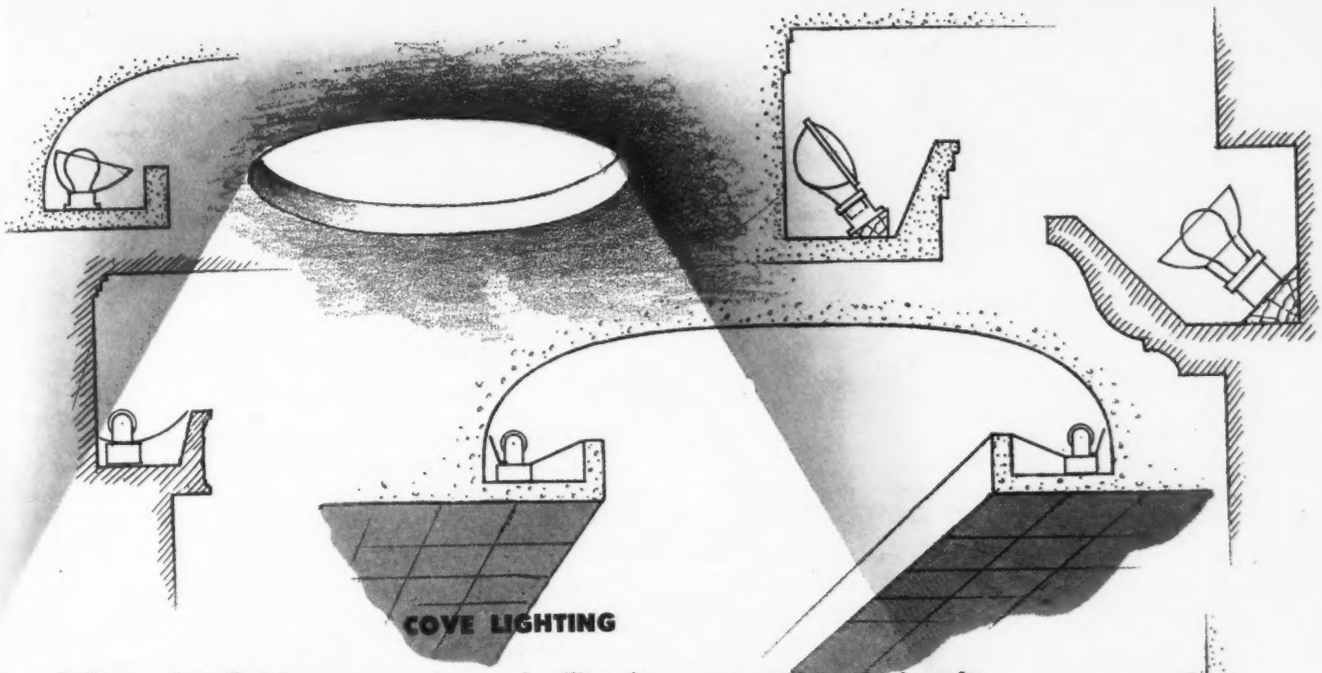
SHIELDED LAMP REFLECTORS

Diffuse illumination, or wide angle distribution of light, is obtained from the large diameter mat finished reflector and bowl silvered lamp. Metal cone shield eliminates glare from the upper part of the lamp.

Sell these for Lighting

DISPLAY ROOMS . . . RETAIL ESTABLISHMENTS RESTAURANTS . . . STORES . . . FOOD MARKETS SERVICE ESTABLISHMENTS . . . BANQUET ROOMS BOARD ROOMS . . . LABORATORIES . . . UNDER BALCONIES

These units may be recessed in ceiling, or suspended from the ceiling. The 200 watt to 500 watt sizes are practical for many lighting applications. The wide angle of light spread makes these units ideal for use in areas having low ceilings where an indirect lighting effect is desired.



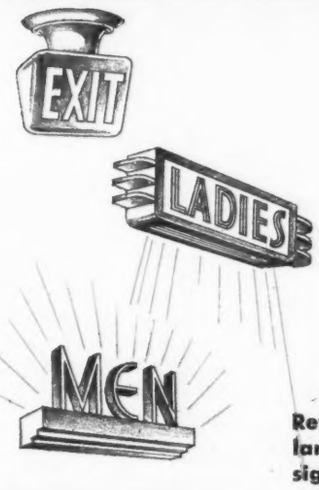
COVE LIGHTING

Reflectors installed in coves, cornices and ceiling domes are used to obtain soft, comfortable indirect lighting, without the use of ornamental or utility type fixtures hanging from the ceiling.

Sell these for Lighting

AUDITORIUMS . . . ART GALLERIES . . . BANKS . . . BOARD ROOMS . . . PRIVATE OFFICES LODGES . . . RECEPTION ROOMS . . . THEATRES . . . RESTAURANTS . . . RETAIL ESTABLISHMENTS . . . CHURCHES . . . PUBLIC BUILDINGS . . . LOBBIES

Fluorescent and incandescent light sources are both easily adaptable to cove lighting. Color roundels can be used with incandescent lamps for color effects, especially where dimming is appropriate. Ceilings or domes should be finished mat white for cove lighting installations.



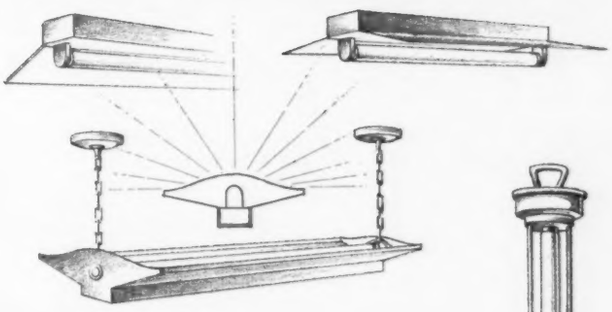
ILLUMINATED DIRECTIONAL SIGNS

Sell these for use in

THEATRES . . . HOTELS . . . OFFICE BUILDINGS STORES . . . RAILWAY STATIONS . . . AIRPORT TERMINALS . . . ALL PUBLIC BUILDINGS

Low wattage incandescent lamps, both standard and tubular types, have long been popular. Small fluorescent lamps are also ideal for luminous signs, and colored lamps add to the effectiveness of the signs.

RELIGHT AMERICA



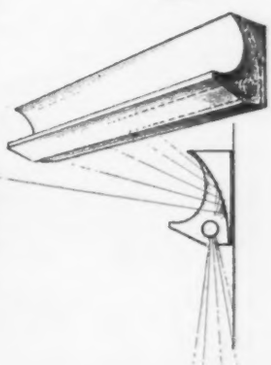
GERMICIDAL EQUIPMENT

Reflector units for use with germicidal lamps are of many types. They are designed for air irradiation for improved public health, and for commercial and industrial irradiation.

Sell these for Irradiating

SCHOOLS . . . HOSPITALS . . . HOMES THEATRES . . . OFFICES . . . RESTAURANTS RETAIL ESTABLISHMENTS . . . POULTRY ANIMALS . . . MEATS AND PRODUCE

Units are available in a wide range of sizes, shapes, and methods of installing. Only a few typical types are illustrated



Outdoor Lighting

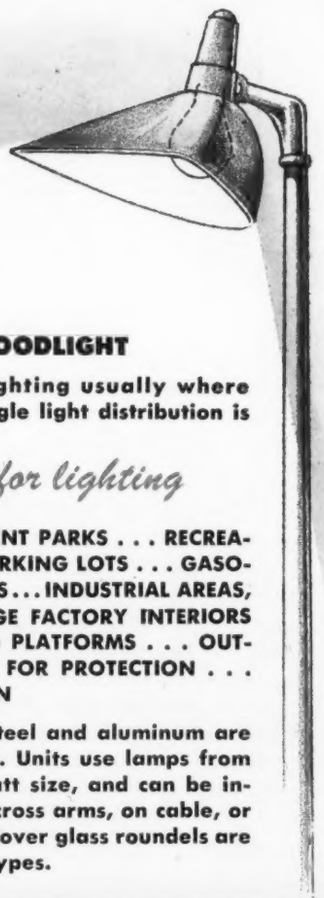
STREET LIGHTING

One of many types of units designed to provide asymmetric light distribution for street and highway lighting.

Sell these for lighting

STREETS . . . HIGHWAYS . . . INDUSTRIAL YARDS . . . PROTECTIVE FENCES . . . PARKWAYS . . . PRIVATE ROADWAYS

Units are available for series and multiple circuits, for use with incandescent, mercury vapor and sodium vapor light sources, with reflectors, refractors, or plain diffusers for light control.



OPEN FLOODLIGHT

For low cost floodlighting usually where medium and wide angle light distribution is required.

Sell these for lighting

SPORTS . . . AMUSEMENT PARKS . . . RECREATIONAL AREAS . . . PARKING LOTS . . . GASOLINE SERVICE STATIONS . . . INDUSTRIAL AREAS, OUTDOORS . . . LARGE FACTORY INTERIORS DOCKS . . . LOADING PLATFORMS . . . OUTDOOR STORAGE . . . FOR PROTECTION . . . NIGHT CONSTRUCTION

Porcelain enameled steel and aluminum are popular for reflectors. Units use lamps from 300 watt to 1500 watt size, and can be installed on pole tops, cross arms, on cable, or on side of buildings. Cover glass roundels are available for some types.

RELIGHT AMERICA

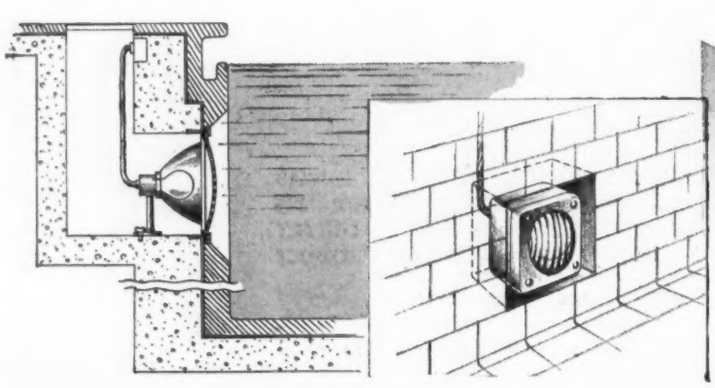
SWIMMING POOL LIGHTING

Provides white or colored under water lighting for private or public swimming pools.

Sell these for lighting

PRIVATE SWIMMING POOLS . . . PUBLIC SWIMMING POOLS . . . TEST TANKS . . . FOUNTAINS . . . AQUARIUMS . . . FISH PONDS

Units are of two types—wet niche and dry niche. Wet niche type units may be immersed in water, as they are watertight. Dry niche type is a standard floodlight installed behind a gasketed glass plate or roundel. Manholes should be provided for servicing dry niche types outside the pool. Flexible rubber cable permits wet niche units to be removed from water for servicing.



ENCLOSED FLOODLIGHTS

Equipped with separate reflectors for beam control, and cover glasses for protection against weather, diffusion, or change of shape of beam.

Sell these for lighting

SPORTS . . . RECREATIONAL AREAS . . . PUBLIC BUILDING EXTERIORS . . . SWIMMING POOLS . . . MONUMENTS . . . LOADING PLATFORMS . . . OUTDOOR SIGNS . . . GARDENS . . . RAILROAD YARDS . . . AMUSEMENT PARKS . . . THEATRE FRONTS

Weatherproof and watertight construction permit units to be used outdoors in any mounting position. Designed for use with 200 watt to 1500 watt standard lamps, and round bulb floodlight lamps. Accessories include louvers, shields, colored glass roundels, diffusing and clear lenses, and rectangular beam lenses.

Cavitation Criteria Shown Photographically

Swiss firm takes stroboscopic pictures to reveal incipience of cavitation with controlled variation in cavitation and in specific quantity of water —Models of hydro runners photographed in immersed rotation

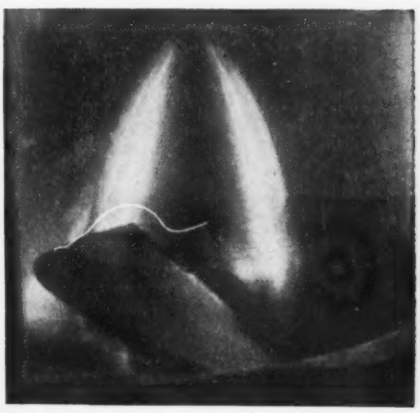


FIG. 1—Taken at 1/200,000-sec. exposure with 20,000-v. flash, spinning turbine runner shows that cavitation number is well below limit for flow being handled

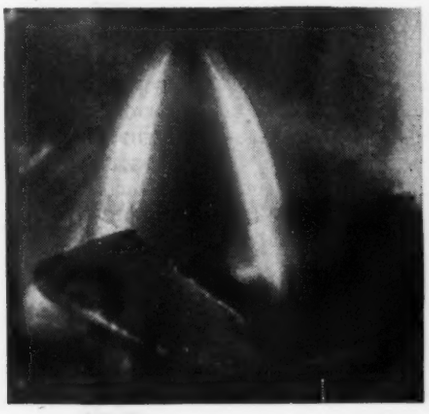


FIG. 2—Slight change in the specific quantity of water causes cavitation at tip and hub of this blade. Note clear view of entire profile

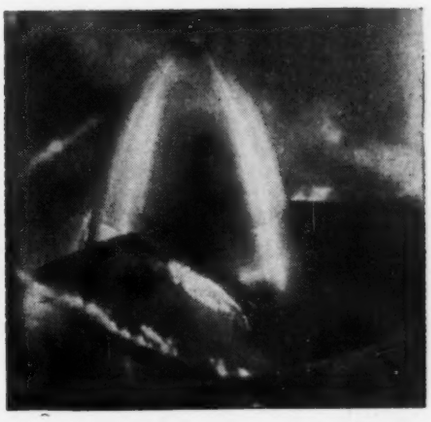


FIG. 3—Fully developed cavitation. From these photos it is possible to determine to what extent operation is permissible without serious attack on metal

MODEL TEST of hydro runners are made by Escher Wyss Engineering Works at Zurich, Switzerland, to lay the basis for designs that will result in minimum cavitation. Flash illumination at 20,000 volts for 1/200,000 second has provided means for studying the effects stroboscopically on 200-millimeter diameter models. Comparison of such tests with stroboscopic investigation of a full-sized 8,500-kw. turbine establishes their validity. Operation at several months duration of overload in the region of cavitation is permissible provided th designs employ suitable metals and correct runner shapes.

The spiral-shaped veils in the draught tube behind the runner indicate microscopically small air bubbles, which separate during cavitation and have not yet been reabsorbed.

In the accompanying photographs the advent of cavitation is indicated as the cavitation number δ and the specific quantity of water are progressively changed. The isolated and unabsorbed air bubbles increase in size and number until there is a pronounced separation of flow and definite zones of cavitation are created. The design is aimed at improving the profiles so as to eliminate points of lowest pressure—the points of origin of release of air and of cavitation.

FIG. 4—Pronounced separation of flow with veils of microscopic bubbles, trailing the runner, not yet reabsorbed. Definite cavitation zones appear on this 8-in. model runner

DIGESTS

Condensations and abstracts of articles in the foreign press, committee reports, unpublished papers before numerous technical societies, research bulletins, standards

Electric Moisture Meter Developed

From a paper by L. Hartshorn and W. Wilson in the "Journal of the Institution of Electrical Engineers" (British) October, 1945.

MOISTURE CONTENT of a great variety of non-metallic materials can be determined with an accuracy within 0.5 percent using an electronic meter devised by the authors. The meter already is being used in several industries, handling such materials as seeds and grain, dried foods and flax straw.

Measurements of a.c. conductance and capacitance are more stable than corresponding d.c. values, and accordingly the meter was designed for use on commercial power circuits, as frequency is not critical. With a vibrator, direct current from a battery may be substituted, making the instrument available for use on farms or other places where no power supply is available.

The material to be tested is made to fill the space between two metal electrodes mounted a fixed distance apart in a rectangular or cylindrical container or cell, which for different materials may have a capacity of from 25 cc. to 16 liters. The conductance and capacitance are measured by a voltage differential in a circuit containing two three-element vacuum tubes and with means for phase adjustment. The current passing through the material is measured with a sensitive thermionic ammeter which can be adjusted to measure the capacitance current proportional to the dielectric constant, the conductance current proportional to the a.c. conductivity, or some function of a combination of these two. The current selected is that which will show the most favorable variation with moisture content.

Some meters have been calibrated to give direct readings of moisture content for a particular material at some standard temperature, while others have an arbitrary uniform scale and are used in connection with calibration charts giving the values of moisture for a range of materials. While there are admittedly errors in the measurements, it is said that with the meter it is possible for unskilled operators to make very rapid tests of the moisture content of materials.

Magnetic Balance Transformer Protection

From an article in "Electrical Review," London, November 16, 1945.

TO PROVIDE instantaneous protection for power transformers, coupled with stability on "through" faults, but insensitive to the effect of on-load tap changing and the rush of magnetizing current when switching in, the British Thomson-Houston Co. has developed a system which is an extension of normal magnetic-balance protection, but which employs an instantaneous relay of the attracted armature type. It is being used in service with a 30-mva. 132/33-kv. transformer of the Coventry Corporation Electricity Department.

Within the protected zone is included a grounding transformer on the 33-kv. side of the power transformer. Current transformers on each phase are dual wound on a common core, one set of windings balancing the protective transformers on the 132-kv. side, while the other set is broken-delta connected in conjunction with the current transformer in the ground transformer neutral. Sensitive protection against 33-kv. earth faults is obtained by an instantaneous relay associated with the latter transformers, while 132-kv. earth-fault, phase-fault, interturn, and intertap fault protection is provided by instantaneous relays connected to the current transformers on that side.

Design of the current transformers follows the normal magnetic balance principle, current in the relay windings being negligible with the circuit normal, while restraint is exercised against the effect of tap unbalance during through faults. By special design, restraint also is exercised within these transformers against false operation due to inrush of power transformer magnetizing current when switching on either the 132-kv. or the 32-kv. side.

Comparatively large secondary currents which would tend to flow in the relay and cause operation when switching in the power transformer were quenched by the restraining action of the protective transformers.

Quantitative tests show full-load current on 132-kv. windings, 130 amp., on 33-kv. windings, 520 amp.; sensitivity to earth fault fed from 33-kv. side, 135 amp., from 132-kv. side, 45 amp.; sensitivity to phase fault fed from 33-kv. side, 120 amp., from 132-kv. side, 30 amp. The time of operation of the protective gear for any nature of fault was not above five cycles.

Fatigue Cracking Of Lead Alloys

From an article by Lawrence Ferguson in "Bell Laboratories Record," New York, February, 1946.

MOVEMENT of lead-alloy sheaths of aerial telephone cables is caused not only by wind but by temperature changes. The motion is greatest at certain points, usually near the poles, and finally leads to fatigue cracking of the sheaths. Corrosion due to rain and chemical effects of the atmosphere also may have an effect.

Fatigue tests were carried out by the Bell Telephone Laboratories on laboratory specimens and also on an experimental pole line. Fatigue life was found to vary with the rate of motion; increase of deflection caused failure after fewer cycles. A coating of polybutene was found protective at high speeds but harmful at low speeds. Other coatings were tried but none that remained fluid adhered well. Paints which were fluid when put on, but dried later, correlated closely in hours of working before failure with the time required to dry.

Cement from Fly Ash

From "Bituminous Coal Research," October-December, 1945.

FLY ASH of moderately low carbon content and moderately high fineness can be used as a replacement for portland cement with improvement in the quality of the concrete, according to Raymond E. Davis, consulting engineer, in a report to the Research Corporation of New York. Fly ashes from 16 sources and portland cements of 9 compositions were investigated, with proportions of ash as high as 50 percent of the mixture. Concretes produced had somewhat lower compressive strength at early ages but substantially higher later on, lower heat of hydration, same or less resistance to freezing and thawing, greater resistance to sulphate action, and greater impermeability at later ages.

Since fly ash collected in boiler plants fired by pulverized coal causes a disposal problem, it is possible that bulk concrete plants in many cities may constitute a market for it.

Developments in British Power Practice

From an address by W. Dixon before the North-Eastern Center, Institution of Electrical Engineers (British), October 8, 1945.

OUTAGES caused by distortion of alternator rotor windings have caused considerable trouble in England. Something better than the palliatives tried so far is needed, in view of the necessity for two-shift operation which involves large and frequent temperature changes. Much of the trouble is laid to working temperatures that are too high.

Hardening of the copper strip for field coils by a definite amount of cold rolling to raise the elastic limit and make it less flexible is said to permit differential expansion without permanent deformation. The need for more rotor current, on the other hand, would necessitate a larger commutator on the exciter, which would be undesirable on direct-driven machines. The objection could be removed by reducing the exciter speed through a 3 to 1 gear, allowing it to run at 1,000 rpm. for 50,000-kw. sets requiring excitation of 180 kw. at 450 volts. It is claimed that this would be preferable to a separate driving motor, although investigations are not yet complete.

During the war, cadmium-copper and steel-cored copper overhead conductors have been used successfully on standard towers to replace steel-cored aluminum (ACSR), but in view of the lower cost the latter undoubtedly will be used again when it is available.

Insulators of toughened glass continue to grow in favor in England for use up to 132 kv. They tend to be slightly cheaper than porcelain, have greater surge strength and are more resistant to mechanical damage and power-arc heating.

In peace time, it was agreed, concrete poles cannot compete in cost with wooden ones for 11-kv. and 20-kv. overhead lines.

Trends in Switchboard Design

From a paper by C. P. West (Westinghouse) before the Pennsylvania Electric Association, April, 1945.

RADICAL CHANGES in switchboard design date from the introduction of the steel panel. It is strong and light and may be finished in many ways. Its edges can be turned and doubled back parallel to the face, providing rigidity and means for joining adjacent units. The flanges form vertical channels to carry the wires, which can be protected by covers, with outlets as required. Holes of any shape or size can be punched cheaply, permitting economical mounting of instruments, control switches, lamps and most relays.

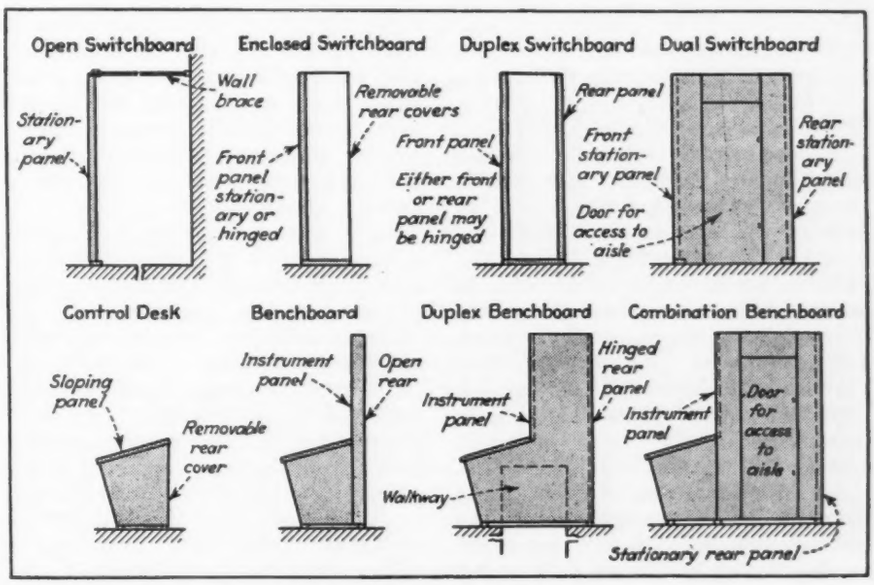
Groups of panels may be assembled side by side in straight lines or curves. Individual panels may be mounted rigidly or hinged for inspection of devices on the rear. Switchboards may be placed back to back with an aisle between, devices for frequent observation being on the front, while the rear carries relays, graphic devices, regulators and the like. Access to the space between the boards is had by hinging one row of panels.

Benchboards also are made up of units in straight-line or curved assembly. The simplest form, used when the operator must look over the top at other equipment, has a sloping desk which carries the control switches, indicating lamps and instruments. Other benchboards have the desk portion placed against one of the various forms of switchboard. Several variations are shown in the diagram. Accessibility is provided by hinged tops, removable fronts, or setting the desks over openings in the floor.

Since hinged panels have come into common use, flexible wire has been adopted for the connection, the standard 12-gage size being made of 65 strands of 0.010-in. diameter conductor. These usually are clamped near the hinged side of the panel and on the fixed structure, allowing a loop with sufficient slack to permit full panel opening. With a maximum bend of about 75 deg. around a ⅜-in. radius, no breakage has been reported.

The Navy prefers to bundle the wires and run them parallel to the hinge, securing one end of the group on the panel and the other on the fixed structure, the bundle twisting as the panel moves. This arrangement is reliable, but as it takes considerable length along the hinged side of the panel the first method is more commonly employed.

Use of steel panels has permitted a new trend in the design of switchboard mounted devices, which are easily set into the panels instead of being mounted on the surface. Need for in-



CONTOURS of standard switchboards and control desks

spection and maintenance has led to the use of relays in which the operating elements can be withdrawn for inspection, leaving the case in position on the board.

Miniature control, employing instruments, switches, indicating lamps and other devices of reduced size, has been used to some extent in large switchboards or control desks to bring the equipment within easy reach and vision of the operator. Since these smaller elements are less rugged, this form of control has decreased in popularity in recent years.

Three Resistances, 17 Combinations

From a paper by N. W. Lewis in the "Journal of the Institution of Electrical Engineers," (British), October, 1945.

FOUR SERIES, four parallel and six series-parallel connections may be obtained from three resistors, making a total of 17 values of resistance. By so choosing the values of the resistances that they are three terms of a geometric series with a common ratio approximating 11/6, then the 17 values are closely related to another geometric series with a common ratio approximately 6/5. Taking the resistance of the three in parallel as 1, the three should be respectively $r_1 = 1.8393$, $r_2 = 3.3830$ and $r_3 = 6.6223$, the resistance of the three in series being 11.4466. Of the ratios between successive values, twelve will be 1.1915 and the remainder 1.0874.

The series is based on the equation $c^3 - c^2 - c - 1 = 0$. Then a, the ratio between the first and second combinations, etc., is $1/(c - 1)$ and b, the ratio between third and fourth, sixth and seventh, eleventh and twelfth, and fourteenth and fifteenth, is $2/c$.

The steps in order, with their ratios, are: (1) r_1, r_2, r_3, in parallel, 1.0000; (2) r_1, r_2, in parallel, 1.1915; (3) r_1, r_3, in parallel, 1,4196; (4) r_2, r_3 in series, with r_1 in parallel, 1.5437; (5) r_1, 1.8393; (6) r_2, r_3, in parallel, 2.1915; (7) r_1, r_3, in series, with r_2 in parallel, 2.3830; (8) r_1, r_2 in series, with r_3 in parallel, 2.8393; (9) r_2, 3.3830; (10) r_2 r_3 in parallel, with r_1 in series, 4.0308; (11) r_1, r_2, in parallel, with r_3 in series, 4.8026; (12) r_1, r_3 in series, 5.2223; (13) r_2, 6.2223; (14) r_1, r_2, in parallel, with r_3 in series, 7.4138; (15) r_1 r_3 in series, 8.0616; (16) r_2, r_3 in series, 9.6053; (17) r_1, r_2, r_3 in series, 11.4446.

Several methods may be used to make the combinations, the simplest being by sockets and U links. A four-bank rotary switch also may be used if quick changes are desired.

Automatic Stud Welding

From an article by A. H. Bent in the "English Electric Journal," Stafford, England, December, 1945.

DEVELOPMENT of a method by which studs may be attached to other metal by the arc welding process obviates the need for drilling and tapping holes in the plate or structure, screwing in the stud, and in some instances welding it in place to seal the joint against leakage.

The welder is automatic. A pistol grip handle connected to a transformer by flexible leads holds the stud, a tripod pressing against the plate and securing accurate placement. The stud has a small pip on the end, so that when it is placed in position and the starting switch closed, the pip is fused and an arc started, which forms a pool of molten metal on the plate. At the end of a predetermined time the stud is plunged into the molten pool. Any surplus metal is forced out and forms a collar around the base of the stud. The entire operation takes less than 1 sec.

Several sizes are being made by the English Electric Co., capable of welding steel or non-ferrous studs from ¼ in to ¾ in. to plates as thin as No. 16 s.w.g.

Electrodeposition Of Copper

From a paper by Herbert Bandes before the Electrochemical Society, New York, October 24, 1945.

COPPER can be electrodeposited from a wide variety of solutions and in a variety of grain forms. Three types of solutions are available, acid, alkaline, and fused electrolyte. Factors which appear most significant in affecting the deposit are type of solution, current density, temperature, degree of agitation, and nature and concentration of addition agents.

On a tonnage basis the acid copper sulphate solution is the most important, as it is used for electroplating and copper refining. Its advantages are low cost, simplicity and ease of operation, and current efficiency of 95 to 99 percent. Its disadvantages are large grain size, inability to give a uniform coating on complex surfaces, deposition from the divalent ion (requiring 2 faradays of electricity per gram), a dull deposit, and inability to plate directly on iron or steel.

The cuprocyanide solution is the most used alkaline bath, and recent developments have made it efficient and easy to operate. It can be made to give bright deposits. Various modifications have been patented. Solutions of complex copper amines have been tried to some extent; they avoid the highly toxic character of the cyanide solution.

Choice of a particular solution depends on the physical nature of the deposit desired, the basis metal, required thickness of the deposit, time allowable, and cost of materials and energy.

A bibliography which is included in the article covers the recent literature on the subject.

Chimney Houses Plant Offices

From an article in "The Electrician," London, January 25, 1946.

CONSTRUCTION of an unusual chimney is progressing at the Valley Road power station, Bradford, England. The complete structure is 350 ft. high and the internal diameter 22 ft. at the top. Each of four flues will carry away the gases from two boilers evaporating 180,000 lb. per hr. The total weight of 2,450 (long) tons is supported on 120 cast concrete piles topped by a reinforced concrete raft 32 ft. square and 6 ft. thick.

The lower 100 ft. of the structure will be used for administrative offices, so that floor beams and window openings had to be provided by fitting frames into the reinforcement.

Sensitive A.C. Bolometer For Infrared Spectroscopy

From a paper by Frank G. Brockman and C. H. Schlesman presented before the Optical Society of America, New York, October 18, 1945.

DETECTION and recording of radiant energy in infrared spectroscopy has been facilitated by the development of an a.c. bolometer system. The bolometer has two filaments as nearly identical as possible, so that in a bridge circuit the ratio of their resistances remains constant regardless of changes in temperature and current. By allowing the radiation to fall on only one of the two filaments, thereby changing this ratio, detection of radiant energy is effected, as the resistance change of the filament is directly proportional to the radiant energy which it receives.

Various compensations have been nec-

essary to maintain equilibrium despite minor variations in circuit values and in voltage. A tuned amplifier is necessary to discriminate against harmonics of the fundamental 1,000 cycles. The bolometers are harmonic generators, since their time constant is of the same order of magnitude as that of the period of the bridge power frequency.

Since the bridge balance is very sensitive to variations of input voltage, a General Radio Co. Type 723-A, 1,000-cycle vacuum tube fork has been altered and the battery supply replaced by power from a high-stability regulated d.c. power supply patterned after one described by S. E. Miller in *Electronics* for November, 1941. The power obtained is insufficient to supply the bolometer bridge, so that following the fork is a highly degenerative power amplifier, its heater and plate supply being taken from the d.c. supply for the fork, with a harmonic content of less than 0.5 percent.

For recording, the amplified 1,000-cycle current is rectified to supply a d.c. recorder. A permanent record of the spectrum from 2 to 14 microns can be obtained in 40 min. without recourse to photographic procedure; the region from 7 to 14 microns, usually studied in hydrocarbon mixtures, in 24 min. The useful sensitivity (corresponding to 1.1 x 10^{-6} volt) corresponds to a change in temperature of the bolometer of 11 x 10^{-4} deg. C., and the minimum detectable temperature change is 11 x 10^{-6} deg. C.

Meter for Measuring Non-Magnetic Coatings

From an article in "The Electrician," London, January 18, 1946.

THICKNESS of non-magnetic coatings on magnetic bases, such as paints, sprayed metal or electrodeposited layers on steel sheet can be measured directly with a thickness meter developed by Salford Electrical Instruments, Ltd. The instrument, which is portable, has an exploring head which is held against the layer whose thickness is to be measured. The head contains a small transformer, through the primary of which a constant current is passed, and the voltage induced in the secondary gives an indication on a meter, the reading depending on the width of any gap in the transformer's magnetic circuit. Hence it responds to the thickness of the insulating layer. For non-metallic coatings the meter may be calibrated to read directly in thousandths of an inch, but for metallic coatings a calibration chart is available.

Preparing Aluminum For Electrodeposition

From a paper by Helmer Bengston before the Electrochemical Society, New York, October 24, 1945.

ELECTROPLATING on aluminum has become of increased importance as the use of the metal and its alloys broadens. Copper has been used to facilitate soldering, silver to provide good surface, electric contact, or surface conductivity for high-frequency currents. Brass has been used to permit vulcanization of rubber.

An early process was the deposition of nickel and subsequent heating to 240 deg. C., which improves the adhesion. Another is the zinc immersion procedure, which aids in the electrodeposition of many other metals. The adhesion appears to be approximately equal to the strength of the alloy.

Anodic treatment also permits electroplating with smooth surfaces. It does not give good conductivity, as the underlying aluminum oxide has high resistance. The zinc immersion treatment is superior for this purpose.

Designing Transformers To Withstand Stress

From a paper by E. Billig before the Institution of Electrical Engineers (British), December 6, 1945.

ELECTROMAGNETIC forces within a transformer usually are most severe with an internal short circuit, and may cause permanent deformation, decrease of clearances, and further breakdowns. Causes of internal faults include breakdown of insulation between turns, coils or windings, or from any live part to the frame or core, faulty operation of the tap-changing gear or accidental short circuit between tap leads or across the tap terminals.

When an internal fault occurs the mechanical forces reach excessive values and must be overcome by the mechanical strength of the conductors and the supporting structures. With pressures of the order of 1 ton per sq. in., which may arise in large transformers, the conductors may shift in position. Even frequent switching may give rise to cumulative deformation and may lead to serious trouble when a short circuit occurs.

Radial forces in the outer windings, if they are cylindrical, usually can be withstood by the conductors and bracing is not needed. The effect on the inner windings is similar, except that the force is compressive, and if they are made up of thin-walled sections they may collapse. Axial forces are transmitted through the whole length of the winding, compressing the copper and the insulation and supports. In coils of round wire there is a tendency for the wires to slip one over another, especially with thick insulation. In disc windings the axial forces exert a bending moment on parts of the conductor not fully supported. The bending stress at the ends of the windings always should be checked and where necessary the axial dimensions of the conductors should be increased to give greater strength.

Clamps should keep the windings under a pressure strong enough to prevent the slightest movement during the useful life of the transformer. From the standpoint of strength the high-voltage windings should be on the outside, and taps should be removed as far as possible from strong magnetic fields.

To counteract shrinkage not only must the forces be balanced by proper design but suitable insulating materials must be used and arranged to minimize shrinkage in service. Clamps should tie the windings together, preferably without transmitting stress through any other part, and materials should be preshrunk until no more setting will occur.

Surface Preparation For Chromium Plating

From a paper by William M. Tucker and Robert L. Flint before the Electrochemical Society, New York, October 24, 1945.

RELUCTANCE of certain cathode surfaces to accept a deposit of chromium was first countered by the use of an undercoat of copper. Recognizing the difficulties, new methods were developed during the war, particularly for plating steel surfaces to resist wear.

It was found that buffed copper and rolled steel free of grease and oil normally accepted chromium deposits satisfactorily while buffed nickel required special processing. Conventional modern methods of surface preparation seemed adequate. The general technique appeared to provide for the substantially complete removal of any oxide or other interfering film, followed by suitably timed manipulative steps designed to start the chromium plating before any interfering films could form. A maximum effect in the deterioration of the bright plating range occurred at high current density, when interfering films began to re-form on the cathode surfaces.

Editorials

S. B. WILLIAMS, *Editor*

Nothing to Fear from Power Lobby Investigation

THIS is election year and a number of Congressmen who haven't any burning issues or things for which they can claim credit will probably welcome the chance to dust off the old tried and trusted issue of the power trust and its lobby. A bill to investigate lobbies, naming private power as one of them, has been introduced into the House and received more than a little publicity.

There is no need for the power industry to become greatly disturbed over the prospects for such an investigation for there is every reason to believe that the National Association of Electric Companies has done a good clean job during its first six months. On more than one occasion its witnesses have been complimented on their testimony by members of Congress. So long as the industry continues to press its case out in the open through the persuasion of facts it can welcome such an investigation. It is only when there are skeletons in the closet that one should have any misgivings.

Some people will take the position that the clamor is indication that the utilities are making large gains in their fight against public power. It would be a miracle to accomplish that in so short a time. It is, however, to the interest of the public power partisans to try to nip the private power lobby in the bud before it should accomplish something important which, of course, can be taken as an acknowledgment that N.A.E.C. is making progress.

One thing is certain, the private power fellows won't be alone. In fact, if the investigation really gets under way it may develop that the government power lobbies have more to be examined than that supported by private power.

The investigation, whether it ever comes off or not, gives added emphasis to the necessity for lobbies to live in glass houses. There will be times when expedients that would be hard to explain in a hearing will appear to offer possibilities for quick and desirable action. There will also be times when overzealous people in a burst of enthusiasm will do things that can be made to sound crazy. Eternal vigilance is needed to keep the activity on a plane that can never be criticized or ridiculed.

The utilities have just as much right, so long as this is a country of free people, as the farmers, unions, or any other economic group to protect what they believe are their rights and interests. Members of Congress are forever beseeching business to bring their legislation problems to Capitol Hill. Congress likes a lobby that is informative. So long as the private power Washington activities remain on that plane there is nothing to fear and in the long run much to be gained.

Time for Labor and Management to Fish or Cut Bait

THERE will be no stoppage of electric or gas utility services in New Jersey or Virginia if the governors of those two states can prevent it. By their recent actions in halting work stoppages they indicate that they are unwilling to permit a small body of men to disrupt the normal life of their communities, to endanger life or to prevent people from enjoying their right to work, right to be transported, or right to be entertained. Their actions, of course, can be taken as a reflection of public opinion.

Just how strong public opinion is on this subject has never been determined, so ELECTRICAL WORLD is now conducting a survey of customer opinion on work stoppages due to labor disagreement. When published next month it should, unless we are entirely mistaken, be a clear indication of the necessity for finding a way to prevent work stoppages unless some kind of compulsion is to be accepted.

Whenever legislation that would outlaw utility strikes has been introduced it has met with resistance from both sides, but labor and management have offered nothing to take the place of compulsion. It looks as though they had reached the point where they must decide either to fish or cut bait. The public will not be struck against.

Engineering Participation in Public Affairs

AGAIN WE ASK does engineering have a common denominator? What appeared to be an attempt to integrate engineering was the Midwest Power Conference held last week under the auspices of the different interested engineering bodies. When it came to technical matters the men still met with those of like interest without any apparent effort to give all engineers an appreciaion of today's engineering problems. The very fact that the program was broken up into so many parallel sessions was an admission that the interests of even so small a group as power engineers are too varied to admit of common technical denominators.

Other professions have found the same thing to be true as we advance into the realm of specialization, yet they have managed to find a bond which might be called a common social denominator. Is such a thing possible for the engineer?

At the Midwest Power Conference six national engineering leaders found the answer in the responsibility of the

engineers for participation in national affairs. They agreed that engineers must utilize engineering approach on public questions, and that this thinking is essential on questions of adjustment in our modern economy.

What is the engineering approach on matters such as these? How does it differ from the business man's approach? Aren't we perhaps assuming something that might be desirable, but which might be difficult to define with any clarity.

Once more it appears as though there is a desire to run before learning how to walk. If there is an engineering approach to national problems it should evolve from the experiences on the local level. If the engineer wants to be heard on broad social and economic problems, or on matters that involve vast amounts of engineering labor, he must first demonstrate his capacity for contributing to the public welfare.

Simply stated, engineers should be good citizens. Many are participating to the best of their ability in local affairs, but many more are not. Apparently they are waiting for some organization of engineers to assert itself so that they may feel they are having a special voice in national affairs.

This isn't some special service that can be purchased. The right to be heard must be earned by individual participation, first at the local level and then gradually building up. Nor is it something that automatically will attach to engineers who took some economics, history and languages while undergraduates. There is only one royal road, and that is to get into the habit of giving thought to public affairs, just as other professions do, and taking part therein. Perhaps some meeting soon will show what civic minded engineering groups are now accomplishing, and then we can see what is involved in real life.

Nothing Final Until Death Sentence Decision

WITHOUT a single dissenting voice the United States Supreme Court upheld the constitutionality of Section 11 (b) (1) of the Public Utility Act. In affirming the lower court decision in the North American case the court said these things: (1) That 11 (b) (1) is concerned with the ownership of securities; (2) that such ownership necessitates use of the mails and other channels of interstate commerce, and therefore is interstate commerce; (3) that Congress has plenary power over interstate commerce, and therefore the section is invulnerable to attack under the commerce clause. Likewise, it held that the due process rights were not infringed because the divestment process was designed to prevent loss.

In reading the decision there was a certain finality that in no way reflected the closeness of the vote by which the act was passed over a decade ago. And perhaps that may not be wondered at too much, because the precedent cited in the decision was sufficiently voluminous to carry conviction upon the questions raised. Thus, two issues regarding this act have been settled—registration in the Electric Bond & Share case and now 11 (b) (1). There still remains the uncertainty over the very core of the act 11 (b) (2)—the famous "death sentence" clause. This is still to be decided in two cases which the court has heard, and until that decision is handed down, regardless of what has gone before in the way of clearing out the legal jungle, the status of enforcement is virtually unchanged. It is highly doubtful if SEC will make any effort to speed up compliance while the court has these other cases under deliberation.

The First Lighting Show and Marketing Forum

AFTER a year's postponement the first International Lighting Exposition will start next week in Chicago. People from every section of the country are planning to attend in order to see what new designs will be available. The interest seems boundless.

On the part of the manufacturers there is also great interest, for if this exposition is a success it can become an annual event, something the lighting equipment suppliers have wanted for a long time. At the same time there is some timidity on their part right now because of labor and materials and parts limitations that are holding up production. Where these conditions are severe the manufacturers are not going to divulge their entire bag of new designs. They are unwilling to tempt duplication while being themselves unable to produce.

Coming just a few weeks before the industry starts on the preparation of its promotional program for the fall lighting season, the exposition is expected to act as a springboard for launching the most intensive as well as extensive lighting sales effort ever attempted. In addition to the new equipments that will be unveiled in the main tent, there will be different side shows each day featuring a different angle of attack on the lighting market, so that in effect this is not only the first display of its kind, but is also the first broadly sponsored lighting market forum.

This show, in fact, has one principal target, and that is the relighting market. Sensing this might well be the keynote of the exposition, we are indicating in a special section in this issue how to relight America. The commercial and industrial opportunities, it will be seen, are tremendous.

Originally we had given the industry an objective of ten years in which to accomplish this task, but when we see how important industrial and commercial lighting is to the national economy we pray that the job may be done sooner. Whether it is in the factory, the office, the store, the school, the street or wherever,—properly designed lighting will contribute to improved productivity, safety, health. These are essential in battling tomorrow's trends toward higher cost.

Because of the importance of relighting America at this time, we are glad to be able to cooperate with the exposition in the preparation of the special lighting section of this issue.

WASHINGTON COMMENT

By R. N. LARKIN, Washington Correspondent

Changing Complexion of the FPC

THE FEDERAL POWER COMMISSION is a vastly different organization today than it was nine months ago, in the matter of key personnel and membership.

Washington observers are commenting these days about a corresponding difference in its attitude on numerous regulatory problems.

Counsel Changes

Starting last June, the commission has lost and replaced considerable key personnel. First departure was Charles V. Shannon, erstwhile general counsel who successfully maneuvered much of FPC's power jurisdiction through the obstacles of federal courts. Next to go was the commission's only lawyer member, John Scott. He was followed by Basil Manly, then chairman, who through long service contributed considerably to keeping the organization progressive as well as to minimizing its forays. Then departed Harry S. Littman, assistant general counsel in charge of natural gas matters and top man in FPC's expanding natural gas litigation.

At this juncture, two new commissioners were named, Harrington Wimberly, an Oklahoma newspaper publisher, and Richard Sachse, a veteran of utility regulation in California, where he was both chief engineer for and chairman of the Railroad Commission.

Last December, Leland Olds resumed chairmanship of the commission, a position he had held for four years previously.

Attitude Shifts

Last January 1, the commission lost George Slaff, chief counsel for its natural gas investigation. A few days later, Bradford Ross was named general counsel to succeed Shannon.

Conjecture as to whether certain recent decisions would have been the same if rendered by the Commission as it existed prior to June 30, 1945, is fruitless. There is, however, some feeling among qualified observers that many of these decisions would have gone otherwise with the original cast.

One decision which has raised a number of eyebrows is that rendered by the Commission on an application of the Nebraska Power Co. to issue securities for refunding purposes. Chairman Olds and Commissioner Nelson Lee Smith dissented from this one, which involved a determination by the majority that taking jurisdiction would not be proper because the property was passing to public ownership. Faced with the proposition of choosing between whether to consider the transaction from the point of view of the seller or the buyer, the majority chose the latter, causing the dissenting members to observe that:

"To hold with the majority would require us to overrule a long line of unanimous decisions of this commission extending over a period of some eight years. Five of these cases, it may be added, involved dispositions of privately owned facilities to public power districts in Nebraska. . . .In each of these cases, the Commission asserted jurisdiction."

Extending Regulation

Another move by the commission is that which experts construe as an attempt by FPC to assume jurisdiction, through the back door, of the presently unregulated sale of natural gas to direct industrial users. Panhandle Eastern Pipeline Co., now serving Detroit, sought to sell also to Ford Motor Co. at Dearborn, a sale over which FPC normally would not have jurisdiction. For strategic reasons, FPC dismissed the request without prejudice, thus removing opportunity for an appeal, and concurrently issued an opinion holding that the Ford sale would impair Panhandle's ability to serve existing customers.

Some months ago FPC really sent eyebrows skyrocketing when it ruled against an application by the Northern Natural Gas Co. to sell gas for boiler fuel to the Iowa Electric Light and Power Co.'s plant at Boone, Iowa, on the grounds that there was adequate coal supply about 75 miles distant.

Prerogatives Invaded

This invasion of what had been considered management's right to manage was matched recently, in a less spectacular way, by the Commission's opinion and order in a case involving an application by the Oklahoma Gas and Electric Co. for authority to refund some 7 percent preferred stock by issuing new shares and retiring some old ones. OG&E sought to amortize the expense of the transaction over nine years. With Commissioner Sachse dissenting, the majority punched OG&E's proposal all over the lot, then decided that, horrendous as it would be to allow amortization over nine years, it would be proper to allow it over a period of not more than five years. Sachse insisted that, logically, the proposition was either all right or all wrong, and that in his estimation, it was all wrong. Informed observers see in the decision a departure from the "cop-on-the-corner" theory of regulation to one in which the commission substitutes its judgment for that of management, and agree, philosophically, with Sachse that amortization should have been permitted over nine years or not at all.

Onerous Distinctions

Yet another decision which draws comment is that wherein FPC agreed to a Tennessee Gas and Transmission request to lease some pumping stations from the government to boost capacity of its line. The transaction was approved with a stipulation that none of the gas movable as a result of the new facilities be sold for more than 18.25 cents per mcf. Thus, TGT is restricted as to price on part of the output of its line, but not similarly restricted on the remainder of the gas flowing through the same line. It is alleged that this is poor regulation on a number of counts, principally in that it forces a company to take a certificate with onerous conditions or no certificate at all, blocking court appeal if the certificate is accepted, but restricting the ability to render service if the company chooses not to accept the restrictions.

NEWS OF THE WEEK

Engineers Told of Their Responsibility to Society

Midwest Power Conference Attracts 2,500—Speakers Declare Future of Nation Depends on Engineering as Well as on Civic and Political Groups —Continued Load Growth for Years to Come Is Foreseen

Individual and group responsibility of engineers to society in an increasingly technical world was the theme that ran thread-like through many of the sessions of Chicago's Midwest Power Conference, last week. A record attendance of 2,500 gathered to participate in discussions that ranged in scope from estimates of future electric power demands to possible reductions in power cost through atomic energy conversion.

Deep concern over future international measures for controlling manufacture of fissionable material was expressed by P. W. Swain, editor of *Power*, in closing his discussion of atomic energy. From an engineering standpoint he saw little expectancy of revolutionary reduction in the delivered price of power from this new source. The only future possibility for changing his conclusions, he said, lies in some development for converting nuclear energy directly into electricity without passing through a heat-power conversion stage.

While warning against over-optimistic predictions in future requirements for electric power, Howard P. Seelye, The Detroit Edison Co., pointed to continued load growth for many years to come. The easy load has been taken in lighting and power substitution and the future increased load must be gained against stiffer competition for the consumer's dollar. However, he asserted, this should indicate only the approach to maturity and not saturation in growth.

Barring "precipitation of a boom and bust cycle," D. C. Prince, General Electric Co., foresaw high levels of electrical power generation tied to a continued growth in gross national product and in living standards. He concluded that engineers must assume more social responsibility since other groups "cannot be expected to understand the possibilities and limitations of modern productive machinery."

Our nation's future is a problem in civic and human relations for which engineers, scientists and industrial leaders must share greater responsibility with civic and political groups. This was the consensus of panel speakers at a major general conference session. "As a citizen, the engineer must utilize the engineering type of thought in attacking public questions," said Dean A. A. Potter, Purdue. But it is not necessary that the engineer run for office, Roy V. Wright, Simmons-Bordman Publishing Co., pointed out. L. J. Fletcher, Caterpillar Tractor Co., urged more personal contact with local groups for exchange of viewpoints, in order to bring the engineering approach to bear on broad questions of adjustment in our modern economy. Samuel R. Harrell, Acme Evans Co., suggested that the future depends on education in concepts of American principles while Melvin J. Evans, management engineer, concluded that leadership in human relations depends on a personal balance of character often neglected in the technical approach.

WAR LEADERS—Rear Admiral H. G. Taylor and Dan Sullivan, director, Utility Wartime Aid Program, at Conference

Electric Utilities Praised

High praise was bestowed on the electrical utility industry for its outstanding war-time accomplishment by top-ranking engineer officers of both Army and Navy at the "All Engineers Dinner." Rear Admiral J. L. Manning, chief, Bureau of Yards and Docks, represented by Rear Admiral H. G. Taylor, said that utilities, through the work of the Utility Wartime Aid Program in training men to operate power plants on Naval vessels; in making studies and recommendations on power needs for shore installations, and in helping restore service in emergencies, were of "invaluable assistance" to the Navy. D. A. Sullivan, director of the Utility Wartime Aid Program, was commended for the close cooperation obtained under the program. Lt. Gen. Raymond A. Wheeler, Chief of Engineers, praising the war-time accomplishments of the utility industry, said,

"I know of no greater cooperation than that evidenced by those engaged in the production and distribution of power. They met the ballooning demand . . . they furnished us with specialized engineering knowledge . . . they promoted successfully a most efficient conserva-

tion program . . . and increased their potential by pooling facilities under the Wartime Aid Program. . . . For these contributions a soldier's thanks."

Silicones offer a new approach to insulation problems for rotating equipment, in the opinion of G. L. Moses, Westinghouse Electric Corp., but the cost for cable insulation, according to R. J. Wiseman, Okonite Co., will hold their uses to very special cases. Field testing of insulation on all important apparatus in service is of proven value, said A. L. Brownlee, Commonwealth Edison Co., but present methods still leave much to be desired, he concluded.

Damper windings are needed on large hydro-driven generators and may not be justified on a majority of steam driven machines, reversing past practice, asserted William L. Ringland, Allis-Chalmers Manufacturing Co. How pooling of generating capacities by interconnection became a major factor in assuring adequate supply during the war and is justified for continued use through mutual savings in reserve requirements, was explained by C. W. Mayott, Hartford Electric Light Co.

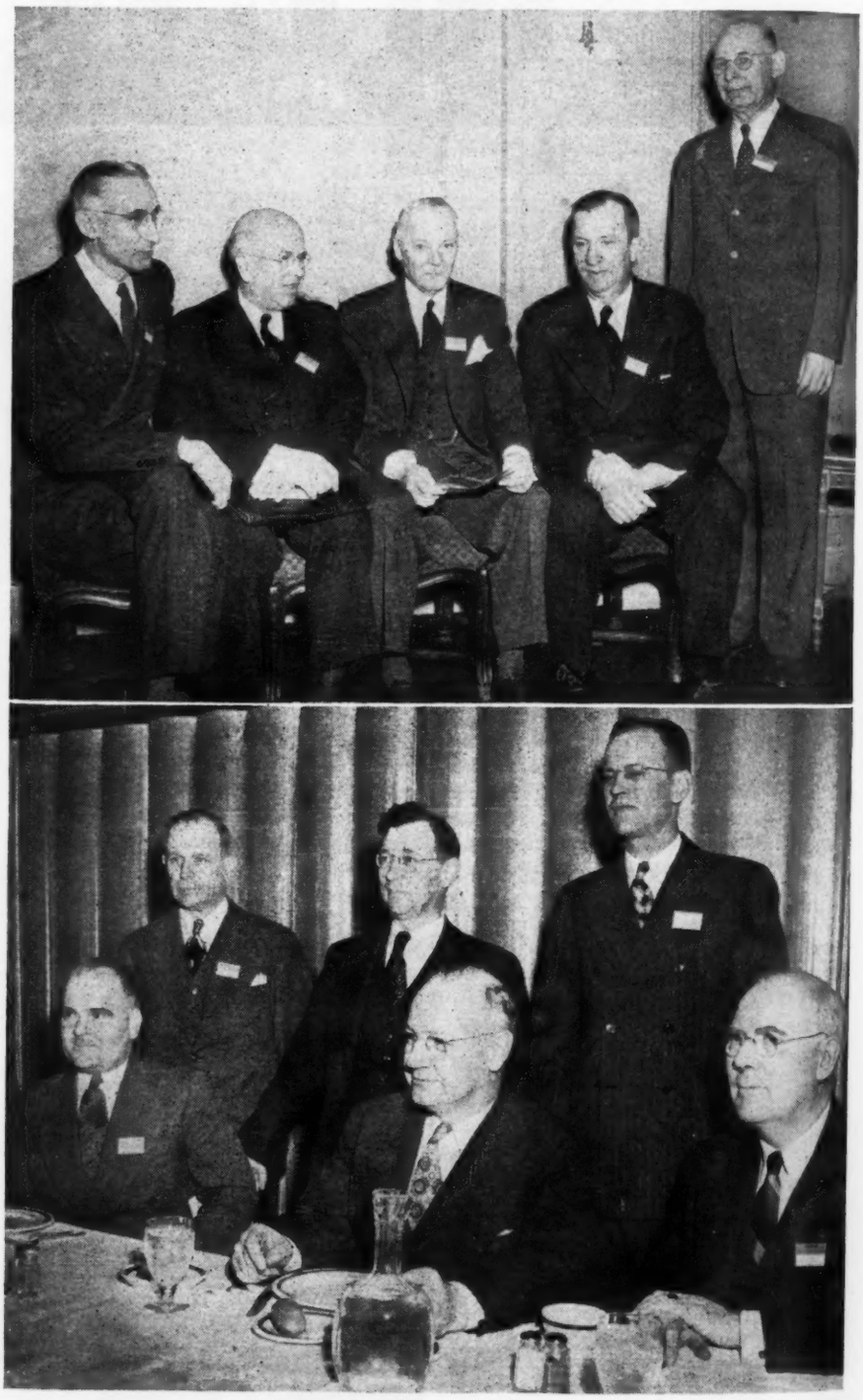
Improve Distribution to Cut Costs

A. Kolflat, Sargent and Lundy, said that in his view electric power costs are "pretty close" to the minimum now; any further reductions must come from improvements in distribution rather than generation. The demand in today's generating stations is for devices to make station operation easier and more automatic, he said. In this connection P. S. Dickey, Bailey Meter Co., felt that success of many new plant designs will depend on proper use of automatic control. He foresaw more extensive use of steam stations capable of quick load pickup and in which automatic control is essential.

The heat pump, with an ideal cycle efficiency of 11.2 percent, provides an economical industrial heat source with an actual coefficient of utilization ranging from 4.6 to 6.7, according to a joint report by Philip Sporn, E. R. Ambrose, and Theodore Baumeister, American Gas & Electric Co. Assuming a coefficient of utilization of 6.0, industrial heat pumps can produce heat at 4.8 cents per million B.t.u. This compares with 29 cents for the same amount of heat produced by an ordinary radiant heater using energy at 1 cent per kw.-hr.

Engineering statistics of the proposed hydroelectric development of the St. Lawrence River and the Missouri River Basin were presented in separate papers by C. H. Giroux, assistant to the chief of engineers, U. S. Army, and B. H. Greene, Federal Power Commission. Greene estimated that for every 75,000 kw. of capacity developed in the Missouri Valley, $50,000 in new industrial plants will be attracted. With nearly 1,750,000 kw. contemplated, he foresaw an investment approaching a billion dollars in new industrial plants.

Two sessions on the gas turbine drew large audiences. A summary paper by L. N. Rowley and B. G. A. Skrotzki, *Power*, presented performance data on gas turbine cycle variations.



AT MIDWEST POWER CONFERENCE—Top panel: Speakers at the opening panel left to right, L. E. Grinter, vice-president, Illinois Institute of Technology; H. P. Seelye, Detroit Edison Co.; James D. Cunningham, president, Republic Flow Meters Co.; P. W. Swain, editor of *Power*; and Dean T. R. Agg, Iowa State College. Bottom panel: Conference luncheon group, left to right, seated, J. C. Marshall, chairman, A.S.M.E. Section; John Michel, Commonwealth Edison Co.; F. H. Lane, Public Utility Engineering & Service Co. Standing, Dr. Otto De Lorenze, Combustion Engineering Co.; A. Kolflat, Sargent & Lundy; and P. F. W. Waller, Jr., Combustion Engineering Co.

Personnel Training Urged at E.E.I. Sales Conference

G. W. Ousler, Duquesne Light, Predicts That Post-War Selling Will Be Harder Job Than Anticipated—R. G. Ely, Public Service Electric & Gas, Newark, Sees War Sales of Power Exceeded in a Few Years

Heaviest emphasis at the Edison Electric Institute sales conference in Chicago last week was on training of men and women for the various phases of the big selling job the electric utilities see immediately ahead. Six of the presented papers were identified by title as treating specifically of sales training and in many of the others the subject was adverted to in more or less detail.

To accomplish the results desired of it, sales training must include modern techniques of instruction as developed by experience in industry and in the armed forces during the war, said R. P. Wagner, New York Power & Light Corp., in urging fullest use of the E.E.I. basic sales training course.

Selling in the post-war time will be a harder job than was anticipated, said G. W. Ousler, Duquesne Light Co., chairman of the commercial division general committee. Because of the immediate and collateral effects of strikes and of the confusions of the time on business operations, pick-up in electrical appliance production has been slow and what would have been an avid market is rapidly changing into one that definitely must be sold.

Electricity should never be sold on its cheapness of cost but on its value to the user—this was the principal advice to the industry in the paper of Gwilym A. Price, Westinghouse Electric Corp. president, which was read for him by G. A. Bucher, vice-chairman of the corporation. In this respect the sales arguments of both electric utilities and manufacturers can and should be greatly strengthened. Production capacity of electrical goods of all kinds is being rapidly expanded and

REGISTRATION LINE—All ready for E.E.I. Twelfth Annual Sales Conference

"Sales; the Eternal Spark Plug" will be more and more required to keep that capacity in full production.

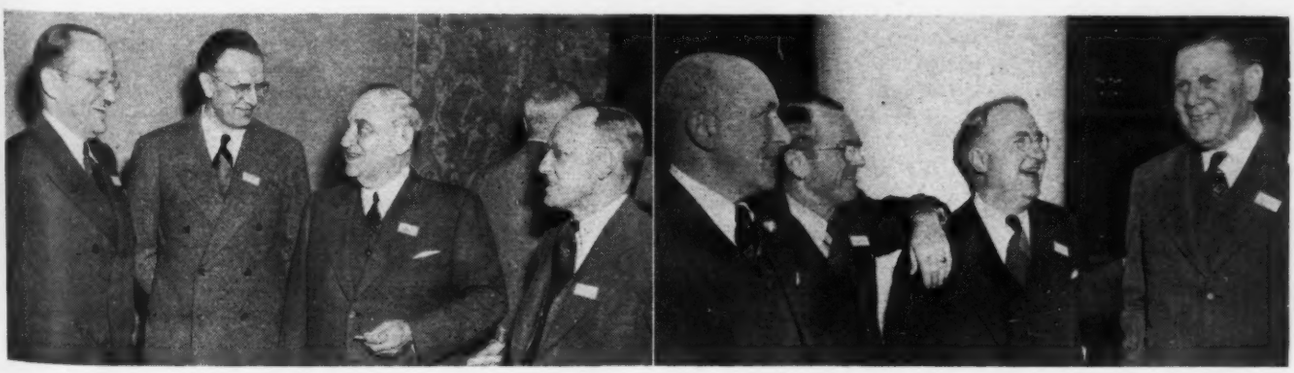
The post-war blue prints of the electrical manufacturers would have resulted quickly in large production if they had been considered and understood by government and accepted by labor, asserted Robert S. Peare, General Electric Co. They can still do so if not hindered further. The manufacturers have not told their story to the people, and they must do it if they are to be allowed to carry forward their future production plans.

If the present industrial load growth continues, the energy sales records of the war period will be exceeded in a few years, predicted R. G. Ely, Public Service Electric & Gas Co., Newark, N. J. Modern developments in electric heating are changing the factors of heat balance by which generation of electricity is justified economically as a byproduct of process steam.

The American Farm Bureau Federation is not a fellow-traveler with those who want the government to take over electric service, asserted R. B. Corbett, secretary-treasurer of that organization. The Federation does not encourage the entry of cooperatives into the business of electricity generation, he said. The best of service is the best protection the utilities can have of their investment in rural electrification. They should take the initiative in working out with farm groups programs for extension of farm electric service and for better use of it.

Frozen food business amounting to 30 or 40 billion pounds annually was estimated by George W. Meek, president, Frozen Foods Foundation, as not unreasonable to expect in a few years. At an average energy usage of 0.275 kw.-hr. per pound, the electric utility sales potential in this field is 8 billion kw.-hr. or more per year. The total connection of equipment for processing and handling frozen foods to the user may be as high as 4 million hp. by 1950.

The heat pump is not a dream, and it is time for the electric utilities to take an active interest in it, asserted M. M. Smith, Muncie Gear Works, who told of the development by his company of a practical domestic heating unit of this type. He urged the cooperation of power companies with distributors of "Marvair" units now being appointed. Energy consumptions ranging from 1,500 to 12,000 kw.-hr. per year, depending on climate, are indicated for these units, making



VICE-PRESIDENTS AND OTHERS—The E.E.I. Sales Conference brought together executives from all sections of the country including this group of utility vice-presidents, left panel, left to right, J. F. Porter, Jr., Kansas City Power & Light Co.; Henry Johnson, United Light & Power Service Co.; C. E. Michel, Union Electric Co. of Missouri; and C. A. Collier, Georgia Power Co. In the right panel is a quartet from the Southeast, left to right, S. P. Vecker and E. N. Pope, Carolina Power & Light Co.; T. L. Bissell, Alabama Power Co.; and W. P. Lyman, Carolina Power & Light Co.

their use attractive at rates utilities can afford to offer.

Nothing sells a new house as readily as a modern kitchen, said Frank W. Cortright, National Association of Home Builders, suggesting a joint committee of E.E.I. and his association. The building industry is confused and concerned as to the government program of home building but accepts with good grace the complicated restrictions imposed by it. Cooperation of all interests concerned with the problems of building and equipping the homes of the nation is essential now as never before.

Lighting is taught in some, and should be taught in all schools, but it won't mean much as a subject of instruction unless the schools themselves are adequately lighted, was the theme of R. C. Putnam, Case School of Applied Science. The utilities have an opportunity and a responsibility in the resources of modern lighting, considering that the school population includes some 30 million teachers and pupils.

Electric water heating is growing in importance as a major load builder, according to papers presented by W. F. Ogden, Edison General Electric, and Roger Bolin, Westinghouse. Over 80 percent of electric utility customers are served on rates suitable for building this load. The water heater utilizes more effectively the customer's investment in better living and, as well, the utility's investment to serve him.

Local public relations must have a background of national understanding, said J. W. McAfee, Union Electric Co. of Missouri, in his address, "Telling the Public through Advertising." Good service and low rates are not enough by themselves to get and hold public regard and the industry can not keep the respect of its friends if it does not fight back against attack.

Preceding the two days of general sessions, the meeting included parallel one-day conferences of the commercial, industrial and rural sales sections and of the residential and home service section. In these conferences, the problems of sales training were also emphasized in papers and discussions.

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Paul B. Sawyer Dies

Paul B. Sawyer, president of the National Power & Light Co., died on April 8 in St. Luke's Hospital, New York, after an illness of two months. He was 66 years old.

Long identified with the public utility industry, Mr. Sawyer was associated for almost 35 years with the Electric Bond & Share Co. System, of which National Power was a sub-holding company.

Lt. Col. Rhea Lapsley Gets Legion of Merit

For his outstanding performance of services as chief, Electrical and Utilities Service Section, Engineering Division of the South Atlantic Division, U. S. Army Engineers, Lieut. Col. Rhea P. Lapsley has been presented with the Legion of Merit. The presentation was made by Brig. Gen. James B. Newman, Jr.

Colonel Lapsley, who was in charge of the electrical part of the Division Construction Program, instituted centralized control in negotiating contracts for utility service at War Department installations in the 4th Service Command. His success in bringing about savings to the government led to his assignment in January, 1943, to review all utility contracts and to secure modifications where possible. In this work, he secured greater reductions in amount and percentage than were secured in any other division or service command.

General Newman, left, and Colonel Lapsley

He has also been field representative of the War Department Power Procurement Officer, for the statutory renegotiation of utility contracts of all government departments with contractors located in the 4th Service Command which were subject to renegotiation under the Renegotiation Act.

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Coast Utility Settles Suit with Bonneville for $185,000

Financial settlement in a civil action brought several months ago by Bonneville Power Administration against Puget Sound Power & Light Co. over $272,739 due Bonneville on power deliveries (Electrical World, August 25, 1945, Page 8) was made when out of court payment was made by the utility recently for $185,000.

According to the original complaint, Bonneville authorities had asked for $1,296,925, covering power deliveries beginning with the expiration of their contract with Puget between October 31, 1944, and July, 1945, and based on applicable rate schedules. Puget, in paying a portion of that amount, had objected to additional payment, terming "unfair" the action of the Power Administration in raising the rates.

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Narragansett Electric Co. Will Improve Distribution

Narragansett Electric Co., Providence, R. I., has announced a $500,000 project to extend present underground facilities and install aerial cable during the next 12 months.

The work includes installation of 4-kv. distribution circuits in existing ducts radiating from the Harris Avenue, Fields Point, and Olneyville substations, which at present carry only high-voltage lines. A new combination underground and overhead system will be installed to serve the northern east side area, including a new substation. The underground extension will cost at least $215,000. Fuses will be provided on all overhead distribution lines supplied from underground lines to limit interruptions to sections where trouble originates. Aerial cable is new to the area concerned but is now accepted as an effective means of preventing storm damage, especially from falling tree limbs.

Under the present overhead system, wires on pole crossarms run parallel with the street. The new construction will eliminate crossarms, the wires being carried on vertical racks, with messenger support. After a severe storm in February, 1945, the company began an extended study of methods of safeguarding its system from major interruptions during storms. It was found that to place all distribution facilities underground would cost about $160,000,000, which would increase several times the rates charged all classes of customers. The project also would have taken years.

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Utility Enters Tax Case

The Virginia Corporation Commission has issued an order allowing the Virginia Electric & Power Co. to intervene in the City of Richmond's effort to boost tax assessments of Vepco properties.

Richmond is attempting to upset the practice of the commission of assessing utilities on a statewide basis at about 40 percent of the properties' market value. The city wishes to assess them like other properties at close to 100 percent valuation.

OPA Suspends Controls on Electrical Equipment

Move Frees Prices on Many Items Used by Utilities but Ceilings Will Be Reapplied if Necessary—Domestic Appliances Not Affected—OPA Freed of Administrative Burden and of Setting New Ceilings

The Office of Price Administration has suspended price control on a long list of electric equipment and much other industrial heavy machinery, but has retained controls over electric appliances even though it suspended ceilings on numerous minor household items.

Administrator Paul Porter noted that the move, which involves merely the suspension, not removal, of price controls, would not affect the cost of living nor result in any substantial increase of business costs. The move frees OPA of considerable administrative burden and saves it the necessity of authorizing new ceilings for many of the suspended products.

It was emphasized that OPA would study the results of its action for price movements and diversion of manpower, materials, and facilities. Price ceilings will be reapplied if experience shows such a move necessary, OPA warned.

Steam, hydraulic, and gas turbines of greater than 150-kw. capacity, electric motors of more than 250 hp., transformers of 500 kva. and over, domestic watthour meters, and specified types of switchgear are among the principal electrical items on which price ceilings were suspended. Also included was much power plant equipment as well as industrial boilers rated 100 psi. and up, and industrial and marine stokers with feeding capacity of more than 1,200 lb. per hr.

Ceilings Kept on Appliances

In its decontrol of consumers goods, OPA emphasized that it did not suspend ceilings on domestic cooking and heating stoves, domestic washing, ironing and most other domestic appliances.

In the heavy equipment field, OPA's suspension affects six major categories, electrical equipment, machine tools, processing, construction, transportation and miscellaneous machinery and equipment. Porter asserted that, in an effort further to control inflationary forces in the field, he will ask the director of War Mobilization and Reconversion to release as rapidly as possible surpluses of such equipment.

"Continued control in these areas," Porter declared, "would have meant a very heavy administrative load. Manufacturers of most of the items affected have experienced or will have increases in production costs due to approved higher wage rates and increases in raw materials costs. Virtually all were affected by the recent steel price increase.

"In addition, the maximum prices of many of these products have been frozen at low levels which were possible only because of the record volume of production or the manufacture of other profitable items or because of standardization of design required by the war. Since the war, volume has been cut substantially, and manufacturers have resumed their wider variety of design with resultant increase in unit costs."

Following is a partial list of items on which price control has been suspended:

Antenna systems and towers, domestic watthour electric meters, electronic metal detectors, electronic tube apparatus over 5-kw. capacity, high voltage metering equipment 1,000 volts and over. Current limiting reactors, above 150 kva.; diesel or gas, or other internal combustion generator sets, or combinations of such type generator sets, 150 kw. and over, including prime movers; frequency converters, all types, rotary and electronic, all integral capacity units; generators, electric, 150 kw. and over; motors, electric a.c. or d.c., 250 hp. and over; phase converters of integral capacity; synchronous condensers of integral capacity; synchronous converters; all turbine generator sets of integral capacity of 150 kw. and over; water wheel generator sets, all sizes and types, including governors.

Transformers, all types, 500 kva. and over; lightning arresters, except 15,000 volts and less for pole and crossarm mounting, and except secondary arresters for use on power circuits 650 volts and less. Neon indicator attachments, except wiring devices, power mercury arc rectifiers over 5-kw. capacity.

Switchgear listed in the National Electrical Manufacturers Association Manual, Part IV, dated January 31, 1946, in subsection of section 8 SG as follows:

8-SG-3 large air circuit breaker group. 8-SG-4 power oil circuit breaker group, except outdoor power circuit breakers 15 kv. and below. 8-SG-5 power switchboard group. 8-SG-5A manual and automatic switchgear assemblies. 8-SG-5B metal enclosed switchgear. 8-SG-5C relays, regulators and miscellaneous switchboard devices sold separately. 8-SG-6 power switching equipment groups, except that for 15,000 volts and less.

NEW JERSEY TAKES OVER—First test of New Jersey's new law allowing the governor to take over a utility in case of a strike was made last week when the state took over the gas plants of Public Service Electric & Gas Co. The men have since submitted their demands for arbitration. Anthony Pinto, head of the Harrison Gas Works Employees Association, reads Governor Edge's order. The others, left to right, are Sgt. Vincent Brooks, state police; Peter B. Higgins, deputy chief of police of Harrison; and Willard E. Lebo, assistant engineer for the utility

T. E. Hienton Heads Farm Electrification Div., ARA

Truman E. Hienton, of West Lafayette, Ind., has been appointed head of the Division of Farm Electrification in the Agricultural Research Administration. He will operate at Beltsville, Md.

Before joining the Army in the recent war, Hienton was in charge of the farm

electrification research at Purdue University's Indiana Agricultural Experiment Station, where he supervised more than 20 projects aimed at determining practicability of the use of electricity for farm operations, ranging from electrical brooding to ultraviolet irradiation for dairyhouses.

Among the projects Hienton will supervise at Beltsville will be development and improvement of methods and machines for barn handling and curing of hay and drying of other farm produce; development of better and safer methods of curing tobacco; investigation of electrical refrigeration phases of on-farm storage of farm produce; and study of recent developments in electrical energy-radiating and bactericidal equipment to determine its applications to agriculture.

Hienton was graduated by the Ohio State University and was awarded a masters degree in agricultural engineering by Iowa State College. A veteran of both wars, he was a lieutenant colonel of ordnance in the most recent, directing supply for 12,000 troops in Iran for a year. Thereafter he was civil affairs officer on Leyte and Mindanao for the 10th Corps.

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Oregon P.U.D. Feasible

The Oregon Hydroelectric Commission has declared feasible the proposed Malheur County People's Utility District, which includes the Oregon cities of Ontario, Vale and Nyssa. The district has a population of 19,263 and an assessed valuation of $10,527,953. The 4,937 consumers of electricity in the district are served almost entirely by the Idaho Power Co., with a small number served by the Malheur Cooperative Electric Association. An election on creating the district will be held within the next few months.

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Distribution Transformer Ceilings Raised by OPA

Manufacturers of distribution transformers have been given an increase in ceiling prices of about 5.4 percent by the Office of Price Administration. The new maximums are not applicable to instrument transformers or dry-type transformers other than those of 500 kva. and under for circuits of 600 volts and over or individual transformers for street lighting circuits.

Producers may now use list prices published in 1941 after October 1, of that year. Producers who did not issue new list prices between October 1 and December 31, 1941, may bring their prices up to those of their competitors. Resellers may increase their prices by the percentage amounts that their net invoice costs have been increased.

Revenues Gain, Power Sales Drop in 1945

Electric operating revenues of the larger privately owned electric utilities in the United States amounted to $3,170,460,000 in 1945, compared to $3,107,939,000 in 1944, according to the Federal Power Commission.

The increase in the year's revenues is attributable entirely to increased use of energy by residential and commercial consumers. Revenues from industrial service, which began to decline in midsummer, 1945, amounted to $966,839,000, down 2.8 percent from the previous year. Revenues from residential service were $943,665,000 and from commercial service $665,605,000, representing increases of 6.0 percent and 5.6 percent respectively over 1944. Revenues from sales to all ultimate consumers were up 2.0 percent to $2,884,622,000.

Operating expenses in 1945 amounted to $1,456,248,000, up 2.3 percent over 1944. Electric utility operating income after deductions, including operating expenses, depreciation, taxes, etc., but before income deductions, amounted in 1945 to $756,396,000, an increase of 4.5 percent over 1944.

MEETINGS

Previously Listed

Northwest Electric Light & Power Association—Business Development Section, Portland, Ore., April 15-17; Engineering Section, Seattle, Wash., April 24-26. Berkeley Snow, managing director, 418 Spalding Bldg., Portland 4, Ore.

National Electrical Wholesalers Association—Annual convention, Stevens Hotel, Chicago, Ill., April 21-25. C. G. Pyle, managing director, 500 Fifth Ave., New York, N. Y.

Pennsylvania Electric Association—Residential committee, Harrisburg, Pa., April 22-23; C. M. England, chairman, Pennsylvania Power Co., New Castle, Pa. Commercial committee, New Castle, Pa., May 23; A. G. Garrigues, chairman, Philadelphia Electric Co., Philadelphia, Pa. Rural committee, State College, Pa., May 23-24; W. H. Ferguson, chairman, Duquesne Light Co., Pittsburgh, Pa. Engineering Section, all committees, Penn Harris Hotel, Harrisburgh, Pa., May 28-29; E. S. Shew, chairman, Philadelphia Electric Co., 900 Sansom St., Philadelphia, Pa.

Society of the Plastics Industry—National plastics exposition, Grand Central Palace, New York, N. Y., April 22-27. John Wetherby, secretary, 295 Madison Ave., New York 17, N. Y.

American Institute of Electrical Engineers—Northeastern district, Buffalo, N. Y., April 24-25; summer convention, Hotel Statler, Detroit, Mich., June 24-28. H. H. Henline, secretary, 33 W. 39th St., New York 18, N. Y.

Southeastern Electric Exchange—Annual conference, Edgewater Gulf Hotel, Edgewater Park, Miss., April 24-26; spring power sales conference, Battery Park Hotel, Asheville, N. C., May 23-24. J. W. Talley, executive secretary, 303 Haas-Howell Bldg., Atlanta 1, Ga.

International Lighting Exposition — Stevens Hotel, Chicago, Ill., April 25-30. A. B. Coffman, manager, 111 W. Jackson Bldg., Chicago 54, Ill.

Edison Electric Institute—Engineering committees, Edgewater Beach Hotel, Chicago, Ill., May 6-7; annual convention, Waldorf Astoria Hotel, New York, N. Y., June 3-5. Col. H. S. Bennion, managing director, 420 Lexington Ave., New York 17, N. Y.

National Association of Corrosion Engineers—Annual convention, President Hotel, Kansas City, Mo., May 7-9. Elton Sterrett, executive secretary, 318 Southern Standard Bldg., Houston 2, Texas.

Arkansas Utilities Association—Annual convention, Arlington Hotel, Hot Springs, Ark., May 13-14. R. E. Ritchie, secretary, Arkansas Power & Light Co., Little Rock, Ark.

Great Lakes Power Club—Spring meeting, Palmer House, Chicago, Ill., May 24. Almer Skretting, secretary-treasurer, Wisconsin Electric Power Co., Milwaukee 1, Wis.

National Fire Protection Association—Annual meeting, Hotel Statler, Boston, Mass., week of June 3. R. S. Moulton, technical secretary, 60 Batterymarch St., Boston 10, Mass.

National Electrical Manufacturers Association — Special sections meetings, The Homestead, Hot Springs, Va., June 17-19. W. J. Donald, managing director, 155 E. 44th St., New York 17, N. Y.

American Society of Mechanical Engineers—Semi-annual meeting, Book Cadillac and Statler hotels, Detroit, Mich., June 17-20. Ernest Hartford, executive assistant secretary, 29 W. 39th St., New York 18, N. Y.

American Society of Agricultural Engineers — Annual meeting, New Jefferson Hotel, St. Louis, Mo., June 24-26. Raymond Olney, secretary, St. Joseph, Mich.

American Society for Testing Materials — Annual meeting, Buffalo, N. Y., June 24-28. R. E. Hess, assistant secretary, 260 S. Broad St., Philadelphia 2, Pa.

Canadian Electrical Association — Annual meeting, Banff Springs Hotel, Banff, Alberta, Canada, June 26-28. B. C. Fairchild, managing director, 704 Tramways Bldg., Montreal 1, Que., Canada.

Utilities Have Ample Supply of Soft Coal

Electric power utilities averaged 84 days' supply of coal on March 1 and presumably added to these stockpiles during the high production weeks of that month. Thus the national bituminous coal strike was not regarded in Washington as an immediate threat to electric operating companies.

A week after the strike began, only one request for assistance had been received from an electric utility, and CPA men estimated that, although the stocks which make up the estimated 84 days' supply are somewhat spottily distributed, no serious trouble over coal supply is to be expected for electric utilities until the strike has been in progress for a month or six weeks.

Coal in transit at the time of the strike was frozen by the Solid Fuels Administration, which authorized its district managers to dole it out to preferred users demonstrating that their stocks are down to 10 days' supply or less. Included in the list of preferred users are hospitals, gas utilities and public health and safety operations. SFA district managers were empowered to direct the frozen stocks to other essential users if the need became serious. Electric utilities could obtain coal under this provision.

Bituminous stocks held by electric utilities March 1 totaled 14,802,000 tons, almost half a million tons above the February 1 level. Days' supply rose during February from 78 to 84 as utilities took advantage of increased weekly output to replenish their stocks.

Consumption during February dropped 13.5 percent from January burn, totaling 4,937,000 tons. Average daily consumption in February was 176,322 tons.

Average number of days' supply on hand March 1 by regions was as follows: New England, 80 days, up two from February 1; Middle Atlantic, 70 days, up 5; Ohio, 92 days, up 13; Michigan, 70 days, up 8; Illinois-Indiana, 62 days, up 2; Lower Missouri Valley, 55 days, up 1; Lake Dock Territory, 85 days, down 11; Southeast, 213 days, up 41; Southwest, Mountain and Pacific, 146 days, up 14; total all regions, 84 days, up 6. The total for all regions was also up 26 days from the average supply on January 1.

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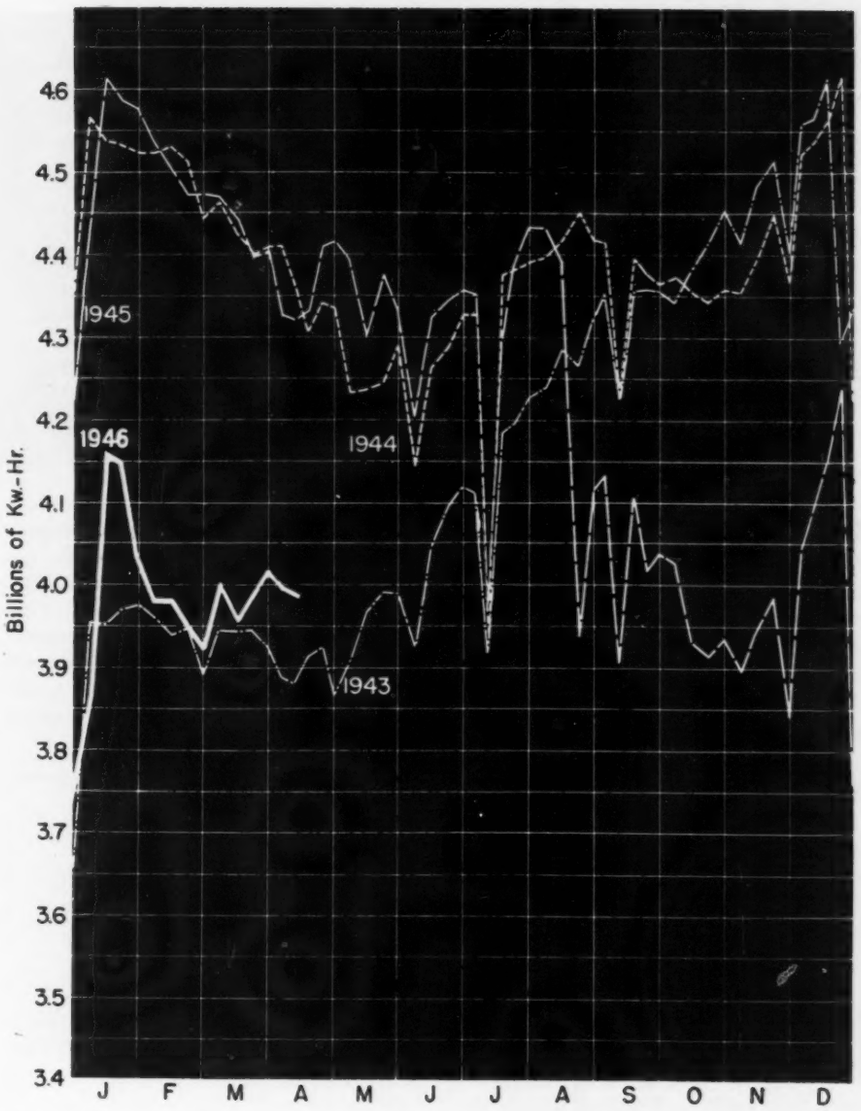
Puerto Rico Buys Floater

The 30,000-kw. "Sea Power," floating power plant built by the Defense Plant Corporation and turned over to the Army, has been sold to the Puerto Rico Water Resources Authority for $2,500,000, the War Assets Corporation has announced.



Output Curve Moves Downward Again

The electric output curve moved downward again during the week ended April 6, 1946, according to figures released by the Edison Electric Institute. The amount of electrical energy distributed by the light and power industry totaled 3,987,673,000 kw.-hr., compared with 3,992,283,000 kw.-hr. during the preceding week. During the week ended April 7, 1945, the amount of electrical energy distributed amounted to 4,321,794,000 kw.-hr., this year's figure representing a decrease of 7.7 percent.

Again the Rocky Mountain States was the only one of the seven major geographical regions of the country which showed an increase for the week ended April 6 as compared with the corresponding week of 1945, showing an increase of 4.7 percent. Three of the other groups reported increased losses for the week ended April 6 as compared with those reported for the preceding week and three showed reduced loses. The biggest decrease was shown by the Pacific Coast States—12.2 percent.

Weekly Output, Millions Kw.-Hr.

1946		1945		1944	
Apr. 6	3,988	Apr. 7	4,322	Apr. 8	4,361
Mar. 30	3,992	Mar. 31	4,329	April 1	4,409
Mar. 23	4,017	Mar. 24	4,402	Mar. 25	4,409
Mar. 16	3,988	Mar. 17	4,398	Mar. 18	4,400
Mar. 9	3,953	Mar. 10	4,446	Mar. 11	4,426
Mar. 2	4,000	Mar. 3	4,472	Mar. 4	4,465
Feb. 23	3,923	Feb. 24	4,474	Feb. 26	4,445
Feb. 16	3,949	Feb. 17	4,472	Feb. 19	4,512
Feb. 9	3,983	Feb. 10	4,505	Feb. 12	4,533
Feb. 2	3,983	Feb. 3	4,539	Feb. 5	4,524
Jan. 26	4,034	Jan. 27	4,577	Jan. 29	4,524
Jan. 19	4,145	Jan. 20	4,588	Jan. 22	4,532

Percent Change from Previous Year

	Week Ending		
	April 6	March 30	March 23
New England	— 1.0	— 2.7	— 6.1
Mid Atlantic	— 0.2	— 1.4	— 3.6
Central Industrial	— 11.6	— 13.6	— 13.6
West Central	— 2.5	— 0.2	+ 0.7
Southern States	— 9.4	— 8.4	— 8.9
Rocky Mountain	+ 4.7	+ 3.8	+ 4.0
Pacific Coast	— 12.2	— 10.7	— 10.8
Total United States	— 7.7	— 7.8	— 8.7

Illinois Utilities Cited by Navy for Services

"For meritorious service and outstanding performance rendered beyond normal responsibility during World War II," the United States Navy awarded certificates of appreciation last week to the management and employees of the Commonwealth Edison group of companies. The four firms; Commonwealth Edison Co., Public Service Co. of Northern Illinois, Western United Gas & Electric Co. and Illinois Northern Utilities Co., are the first utilities in the nation to receive these citations.

Rear Admiral H. G. Taylor, superintendent civil engineer of Naval Area 5, made the presentations to Charles Y. Freeman, chairman of the companies. Ralph A. Bard, former undersecretary of the Navy, Vice-Admiral George D. Murray, commandant, 9th Naval District, and Edward J. Doyle, president, Commonwealth Edison Co., also spoke.

Participating in the ceremony were Captain Edward A. Hayes, USNR, who served as special assistant to the late Secretary of the Navy, Frank Knox; Murray F. Humes, who was special assistant to Donald Nelson, chairman of the War Production Board; Commander Ben Evans, Public Works Department, 9th Naval District; Britton I. Budd, president, Public Service Co. of Northern Illinois, and George R. Jones, president, Western United Gas & Electric Co. and Illinois Northern Utilities Co.

This presentation in Chicago is the first of a series of such citations by the Navy that will be given to individual utilities, both public and private, during April and May. The Army also plans to present certificates of appreciation to individual utility employees who have cooperated with the Army under the Utility Wartime Aid Program. These presentation ceremonies, both Army and Navy, will be held during the next few weeks in principal cities of Army Service Areas and Naval Districts over the country.

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Ohio Utility Goes I.B.E.W.

The International Brotherhood of Electrical Workers, A.F.L., was certified as bargaining agent for electrical division employees of the Columbus & Southern Ohio Electric Co. after winning an NLRB election by a six-vote margin.

NLRB meanwhile ordered the Electrical Testing Laboratories, Inc., of New York City to disestablish completely its United Employees and to cease and desist from interfering in any manner with its employees in their attempts to form or join labor organizations.

Courtesy Boston Globe

FOR SCIENTIFIC WAR SERVICE—President Karl T. Compton, Massachusetts Institute of Technology, receives the Medal for Merit from Lt. Gen. O. W. Griswold, commanding general, First Service Command, by order of President Truman, in recognition of Dr. Compton's "exceptionally meritorious conduct in the performance of outstanding services to his country"

Court Surrenders Assets of Utah Power & Light Co.

After receiving affidavits and testimony showing that the Utah Power & Light Co. had carried out all provisions necessary to place the utility's reorganization plan into effect, the Federal District Court in Salt Lake City signed an order surrendering its jurisdiction of the company's assets.

Judge Tillman D. Johnson had taken formal control when the court approved a request of the Securities and Exchange Commission that the Utah firm cease to be financially connected with the Electric Power & Light Corp., and Electric Bond & Share. (ELECTRICAL WORLD, February 2, Page 81.)

UTILITY REPORTS

	Net Income 1946	1945
*Alabama Power	$6,016,812	$6,918,689
*Birmingham Electric	1,132,117	1,619,652
*Georgia Power	5,749,399	4,889,118
*Houston Lighting & Power	3,080,267	3,045,116
*Texas Electric Service	2,938,529	1,797,129
	1945	1944
†Buffalo Niagara Electric and subs	6,117,966	5,828,395
†New Jersey Power & Light	1,428,511	1,409,506
†New York Power & Light	4,058,368	2,823,108
†Northern Indiana Public Service	3,470,518	3,350,281
†Union Electric (Mo.) and subs	8,535,963	9,019,392
†Wisconsin Gas & Electric	604,554	619,388

*Twelve months ended February 28.
†Twelve months ended December 31.

G.E. Endorses Suspension of Price Controls by OPA

The action taken by OPA in suspending price control on several classes of capital goods including many items of heavy electrical machinery was endorsed today in a statement by R. C. Muir, vice-president and general manager of the apparatus department of the General Electric Co.

"It will permit badly needed price adjustments on many of our lines," Mr. Muir said. "It is probably not known generally that in spite of substantial increases in labor and material costs the composite price index of General Electric's capital good products is the same today as it was in 1940 and 1941.

"It has always been our aim to keep prices as low as possible, consistent with fair profits, because we realize that only through this practice will the purchase of our equipment be attractive to a majority of our customers.

"This will always be a compelling influence in the pricing of capital goods manufactured by General Electric. Since we must prove to our customers the benefits resulting from modernization and greater efficiency before we can sell our equipment, the prices are largely self-regulating. Therefore there can be no runaway prices."

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Portland General Electric Ends P.U.D. Case Appeal

Portland General Electric Co. has withdrawn its appeal, filed in the United States Circuit Court of Appeals at San Francisco, in the sale of its Clark County, Wash., properties to the Clark County P.U.D. for $801,000 (ELECTRICAL WORLD, January 26, Page 8). This action terminates all litigation with respect to the acquisition by the P.U.D. of the utility's holdings in Vancouver, Wash., and adjacent territory.

The P.U.D. and Portland General Electric each had submitted claims as to valuation in a jury hearing in United States District Court at Tacoma, the jury fixing the valuation at $801,000. The P.U.D. paid the purchase price and took over operation of the former P.G.E. properties on January 10.

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N.A.W.B. Offers Wyatt Aid

The National Adequate Wiring Bureau, through Herbert Metz, chairman of the executive committee, has placed itself at the disposal of Wilson Wyatt, housing expediter, to aid him in his plan for providing housing accomodations for veterans.

HOW

DESIGN · CONSTRUCT · OPERATE · MAINTAIN

Electric Fish Screen Keeps Intake Clear

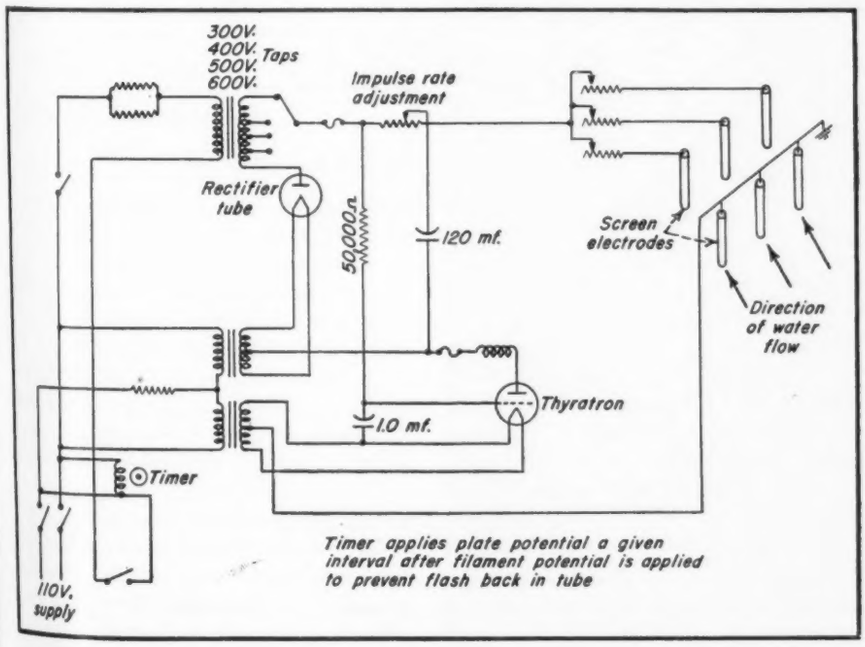
F. L. REINMANN

Manager, Electrical Production, Northern Indiana Public Service Co., Hammond, Ind.

An electric fish screen installed across the mouth of the circulating water intake at Michigan City Generating Station has virtually eliminated regular spring and fall attacks by migrating minnows and perch up to 6 or 8 in. long that at times were a serious threat to plant operation. Effect of the screen is to produce electrical impulses in the water zone around the barrier that are disagreeable, yet harmless, to the fish and will cause them to swim to neutral areas.

The fish screen equipment consists of two principal parts: (1) An electronic impulse generator which operates from 110 volts, 60 cycles to produce electrostatic impulses at a rate which can be varied from about 5 per second, when a large number of very small fish are running, to 1 per second between seasons when the fish are not migrating. Voltage of the impulses can be varied from 300 to 600 volts. (2) A screen which consists of separate rows of energized and grounded electrodes immersed in the water. Impulses impressed on these electrodes produce a field in the water around the screen which varies in intensity with distance from the electrodes.

Circuit of the impulse generator is shown. Provision is made in the circuit for charging a 120-mf. condenser with direct current through an adjustable series resistance and discharging it through the electrode circuit by triggering the grid of a thyratron tube. Frequency of the impulses is varied by adjusting the time constant of the series resistor-condenser combination, by changing the value of the resistance.



IMPULSE GENERATOR produces electrostatic discharge at rates from one to five per second in water around immersed electrodes, to discourage minnows and fish from entering condenser inlet at generating station. Timer applies plate potential a given interval after filament potential is applied; this prevents flashback in the tube

Electrode Arrangement

At Michigan City the mouth of the intake is divided into three bays each 7 ft. 8 in. wide. The screen in each bay consists of two parallel rows of seven electrodes each. Rows are about 18 in. apart.

Grounded electrodes are on the upstream side. Live electrodes are on the inside and consist of small rods suspended from a cable with a strain insulator at the top so the rod can move freely in the current.

Velocity of water flowing through the screen is an important consideration. If velocity is too high it is impossible for minnows that enter the zone of the screen to turn about and swim upstream away from its influence when they get in the field. At Michigan City the water velocity is 41 ft. per min. through the electric field.

It is apparently more difficult to control tiny minnows than fish that are 5 or 6 in. long. Evidently the effect of the impulse varies with the length of the fish that is subjected to the field. Consequently when the small fish are running it is desirable to speed up the impulse rate.

Effect of the impulse can be felt by placing a hand in the water in the vicinity of the screen. The shock is neither as strong or as uncomfortable as that received from an automobile

spark plug and appears quite harmless.

Equipment used at this plant is known as the Burkey electric fish screen.

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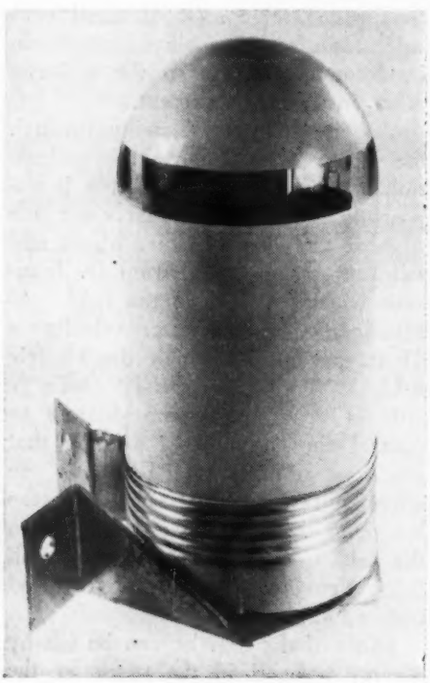
Multiple Street Lighting With Electronic Control

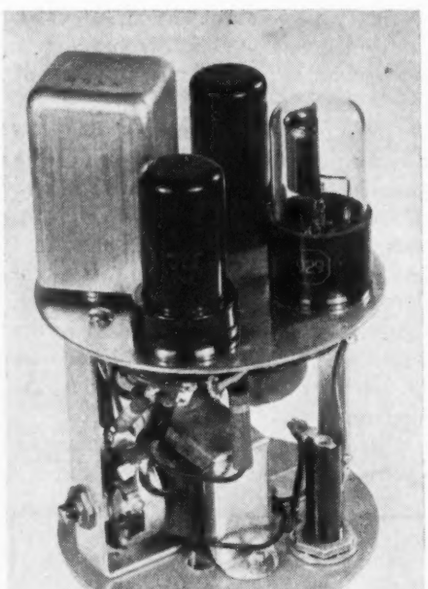
To facilitate multiple street lighting, a photoelectric control unit to govern one or more lamps and designed for outdoor mounting has been developed by the Fisher-Pierce Co., Boston, Mass., and is now in field service on several utility systems. Automatic control of individual lamps on daylight setting has the advantages of flexibility as to installation and location; close control of circuit starting and stopping compared with variations of judgment (often 15 min.) and light intensity between areas under manual or time clock control; control up to 500 watts of incandescent lamp load directly; and simple maintenance requiring no field servicing. With multiple lamps thus controlled no planning or advance knowledge as to future street lighting service expansion is needed other than provision for increased load. It is only necessary to mount a street lighting fixture on the distribution pole, to connect the leads from the luminaire fixture to the control unit, and to connect the control unit directly to the distribution wires.

The unit has been designed to give dependable operation down to the 0.5- to 1-footcandle range; for 1-year minimum life of replaceable tubes; minimum change of operating values with life; definite operating differential to avoid "cycling;" definite time delay to avoid turning off from motor-vehicle headlights, lightning, etc.; "fail-safe" (i.e., with the light on) in case of failure of circuit transformer, contactor, coil, output tube, etc.; and fusing to remove unit and lamp load from the line in case of surge or short circuit in unit or lamp load. The operating voltage is 105 to 130 range, 50 to 60 cycles. A 30-amp. capacity will be available later. The energy consumption of the unit is 6 to 7 watts; photocell sensitivity 0.5 to 6 footcandles; and time delay, 15 to 20 sec. The estimated life of the unit's tubes is 10,000 hr. to 15,000 hr., and for the phototube, 25,000 hr. All parts are designed to be unaffected either operationally or physically by wide temperature, humidity and other climatic and weather extremes. Mounting by a lineman with the device oriented to the north light is easily done, a heavy galvanized mounting bracket being used.

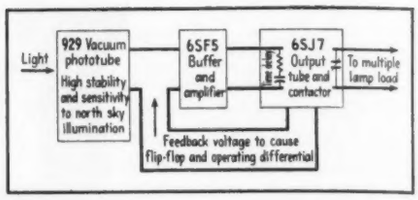
A low-voltage multiple system usually eliminates investment in special high-voltage wires, poles and constant current series street lighting transformers. The economics of each situation varies; but the simplicity of the multiple system is responsible for increasing interest in this method among utility engineers.



EXTERNAL VIEW of photoelectric control unit for multiple street lighting service, designed for outdoor mounting



INTERIOR VIEW of photoelectric control unit, phototube at extreme right


Light
929 Vacuum phototube
High stability and sensitivity to north sky illumination
6SF5 Buffer and amplifier
Time delay
6SJ7 Output tube and contactor
To multiple lamp load
Feedback voltage to cause flip-flop and operating differential

BLOCK DIAGRAM of street lighting control unit. A stable high-vacuum phototube with high sensitivity to north sky light (RCA 929) directly controls a type 6SF5 triode, which acts as a buffer tube and operates at less than 0.1 maximum rating. The latter tube controls an output tube (type 6SJ7), which directly operates a contactor having a 15-sec. time delay in its grid circuit due to a condenser-resistor combination. The operating differential is secured by introducing a fixed voltage from this output stage directly in series with the phototube-buffer tube signal circuit. The feedback gives a "flip-flop" action; i.e., the circuit becomes unstable, snapping over when the operating points are reached. The contactor carries the load on its normally closed contact. The entire unit is fused for 15 amp.

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Distribution Staff Duties Summarized*

Maintenance Engineer

In this utility the maintenance engineer is responsible for distribution engineering and the general layout of the distribution system in so far as such is done by the local company. He requests the necessary work orders to the proper department for the construction and maintenance of overhead and underground lines, indicating the general sequence of such pieces of work and following up such jobs whenever necessary to make certain that they are being done in the order indicated. Upon him is the responsibility for the preparation of detailed plans and specifications to cover fully these work or-

* One of a series of presentations covering the essential duties of officials of a public utility distribution department serving between 50,000 and 75,000 meters. First installment in ELECTRICAL WORLD, October 13, 1945, page 106.

ders and for causing the necessary permission or easements to be obtained by the estimating department.

When the above work has been approved by the superintendent of distribution, the maintenance engineer is required to inform the stores department of any unusual demands that will be made for materials regularly kept in stock, stating their approximate amounts and required delivery times. He has to inform the meter superintendent of any installation to be made by the distribution division which includes meters or instruments to be operated by instrument transformers, so that the meter superintendent may be present when the installation is made alive. The maintenance engineer is also responsible for laying out proposed plans for changes in the construction and maintenance of overhead and underground lines necessary to correct reported conditions of low voltage, transformer overloads, unbalanced phases, overloaded circuits, necessary lightning arrester protection, condemned poles, manhole or conduit repairs, etc., but he is not responsible for detecting the need for such changes.

Street Construction

He is required to keep informed so far as possible of all changes in street construction planned by the municipalities, so that he may plan in advance for required distribution system changes. Another responsibility is for important or extensive joint line construction, and consultation with the field engineer of the foreign company. In his province are also electrolysis and duct temperature surveys, and the testing of driven grounds; and also the initiation and follow-up of all matters within the distribution division relative to the securing of grants of location for poles, manholes, conduits, and permits to lay laterals in public ways. The keeping of records of street lights and traffic signals is his duty. When substantial changes are made in the 2.3-kv. cable system (or below) the usual checks are made by cable splicers, but afterwards the maintenance engineer is required to see that tests are made by the Lundin set or regulator method for phase identification. He determines the selection of the manhole casting and cover to be used on every job and designates which covers are to be recut or junked. He also is responsible for the amount of fiber conduit and different types of named cutouts to be kept in stock and used on specific jobs.

Further duties include preparation of plans where transformers are to be installed on the ground or old ground installations rebuilt; necessary requisitions for purchase orders to require contractors to do stated overhead or underground work; the investigation of every case where street excavation is proposed or being done, furnishing the department or foreman in charge of the work with a sketch or other essential information as to the location of company plant in this area; and the frequent visiting of such work to protect company property and provide orders for moving it if necessary. He checks and initials when correct all circuit map tracings for electrical layout before blueprints are ordered. Upon him also fall responsibilities for the preparation of a monthly (before the sixth day) report of "Distribution of Current Generated and Bought," cable trouble records (joints and potheads), cable tracer records, gas tests; and he is on call to handle unusual trouble. He also allots lead cable economically.

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Accident Report Form Fosters Self-Analysis

This four-page accident report form used by the Texas Power & Light Co., Dallas, for reporting all employee accidents, other than vehicular accidents or those involving the public, is in effect a self analysis. Filled out by the responsible supervisor, answers to the analytical questions help him determine the cause as related to supervisory or employee responsibility. Immediate preventive measures can then be taken. The report is in the form of an 8½ by 11-in. folder. It is used to cover minor or major injuries.

Report of an Injury to an Employee

TWO COPIES OF THIS REPORT MUST BE MAILED TO THE INSURANCE AND SAFETY DEPARTMENT WITHIN 24 HOURS AFTER ACCIDENT OCCURS

The Office Must Report Any Injury to the Industrial Accident Board Within Eight Days After Injury Occurs or Be Subject to Penalty.

NOTE: There is only one way to properly fill out this report—to conduct such an investigation as will determine all the fundamental causes leading up to the injury. Too much detailed information cannot be given regarding the accident.

Name of injured person

District or Dept. Date

INSTRUCTIONS

This report should be made out to cover all injuries to employees, whether of a minor or serious nature. An answer must be made to every question where at all possible, and any other facts not covered in this report shall be fully stated.

Date of accident ..... 19.... Hour ..... M.
Weather conditions .....
Date of this report ..... 19....
1. Name of injured person ..... 2. Race ..... 3. Age .....
4. Employed at ..... District ..... Dept. .....
5. Injured's address .....
6. Position .....
7. Single ....., Married ....., Widowed ....., Divorced ....., Separated but not divorced .....
8. Length of service with company .....
9. How long employed in present position? .....
10. Does injured carry group insurance ..... Amount $ .....
11. Name of engineer or foreman as shown on monthly departmental accident summary to whom this accident should be charged .....
12. Name of foreman directly in charge of man on job .....
13. Where was he when accident occurred? .....
14. Exact location of place where accident occurred .....
15. What town? .....
16. Names and addresses of eye witnesses to accident .....
17. If no eye witnesses, names of employees on same job .....
18. Attending physician ..... Address .....
19. Name of hospital ..... Address .....
20. Date employee stopped work on account of injury .....
21. Probable length of disability (estimate in days) .....
22. Give nature and extent of injury (detail part of body injured and extent, such as burns, sprains, broken bones, etc.) .....
23. What statement did injured person make as to cause of the accident? .....
24. ..... (the above statement?

25. How did the accident occur? (What was injured doing? Give full details, describe tool used, type of construction, etc. If possible, attach rough sketch or picture showing conditions existing at the scene of the accident.) .....
26. How long had injured been doing this type of work? .....
27. What instructions, if any, had been given to the injured person in respect to how to do the work, and by whom? .....

CAUSES OF ACCIDENT

Place a check mark beside any of the following items which, in your opinion contributed to the accident:

28. SUPERVISORY RESPONSIBILITY
A. INSTRUCTIONS
(1) Total absence of instructions ..... (2) Erroneous instructions .....
(3) Inadequate instructions .....
B. DISCIPLINE
(1) Failure to enforce Rules and Regulations .....
C. FITNESS FOR WORK
(1) Class of work beyond mental ability of injured ..... (2) Class of work beyond physical ability of injured ..... (3) No check made on injured's qualifications for work .....
D. WORKING PRACTICES
(1) Lack of teamwork ..... (2) Undue haste ..... (3) Insufficient help .....
(4) Hazardous chances ..... (5) Lack of proper supervision .....
E. WORKING CONDITIONS
(1) Improper storage of materials ..... (2) Lack of good housekeeping .....
F. PLANNING AND LAYING OUT OF OPERATIONS
(1) Total absence of planning ..... (2) Inadequate planning .....
(3) Improper methods ..... (4) Defective design .....
G. PROTECTIVE DEVICES
(1) Protective devices not provided ..... (2) Protective devices out of place .....
(3) Protective devices not used ..... (4) Defective protective devices .....
H. TOOLS AND EQUIPMENT
(1) Lack of proper tools and equipment ..... (2) Defective tools or equipment .....
(3) Improper selection of tools ..... (4) Lack of proper inspection .....

29. RESPONSIBILITY OF INJURED
A. ABILITY
(1) Poor judgment ..... Give details .....
B. MENTAL AND PHYSICAL CONDITION
(1) Inattention ..... (2) Failure to think or plan work ..... (3) Doing work in a mechanical manner ..... (4) Worry ..... (5) Lack of rest or sleep .....
(6) Physical condition that existed prior to accident ..... (7) Intemperance .....
C. ATTITUDE
(1) Violation of rules or regulations ..... (2) Taking unnecessary chances ..... (3) Horseplay ..... (4) Failure to co-operate with fellow employees ..... (5) Heedlessness ..... (6) Thoughtlessness .....
(7) Recklessness .....
D. MISCELLANEOUS
(1) Unnecessary haste not ordinarily required to do work ..... (2) Improper clothing or wearing apparel ..... (3) Failure to report injury and get first aid ..... (4) Improper use of tools .....
30. CONTRIBUTORY CAUSES
A. Carelessness of fellow employees or others .....
31. MATTERS BEYOND CONTROL
A. Due to elements or act of God .....
32. Which one of the above causes which you checked do you consider as being the PRIMARY cause of the accident? .....
ANSWER BY NUMBER AND GIVE BRIEF EXPLANATION
33. What could have been done to have prevented this injury? .....
34. What has been done to prevent a recurrence? .....
35. COMMENTS .....
36. If employee was previously injured, state date of last injury and cause .....
PERSON OR PERSONS MAKING THIS REPORT ..... (SIGNED) SUPT. MGR. or ENGINEER
(OR TITLE)

New Pole Mounting For Transformers

T. E. HORKAY
Engineering Dept., Central Illinois Electric & Gas Co., Rockford, Illinois

Study of the allowable weight that can be supported from crossarms has resulted in the evolution of a new method of mounting distribution transformers by Central Illinois Electric & Gas Co., Rockford. The new mounting, which uses only stock hardware items, requires less material than the widely used double-arm type of transformer mounting arrangement.

Accompanying illustrations show details of the scheme as applied to single-phase and three-phase transformer installations. The observation leading to the design of this mounting was that the "back" arm of a double-arm assembly adds little to the strength of the installation since practically no vertical load can be transmitted to it by the double arming bolts from the front arm. In fact, the tendency would be to split the arms in a horizontal plane should the load be such as to bend the bolts. Better use can be made of the wood in the second arm by bolting it immediately below the front arm, as shown.

The following working stresses, established by the Forest Products Laboratory, were used in the investigations. These values provide adequate safety factors for continuous loading, the condition existing in the case of transformer mounting:

Crossarms—Douglas fir, coast region select, occassionally wet

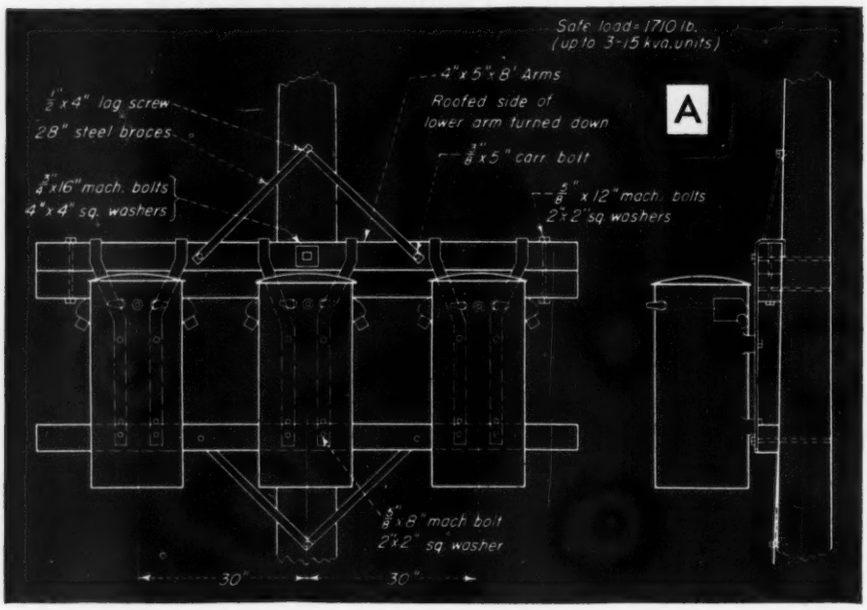
Compression perpendicular to grain—psi.	240
Modulus of elasticity	1,600,000
(Use 800,000 to minimize sag under continuous load)	
Transverse bending stress—5 in. thick—psi.	1,385

Poles—Creosoted yellow pine, common, occasionally wet

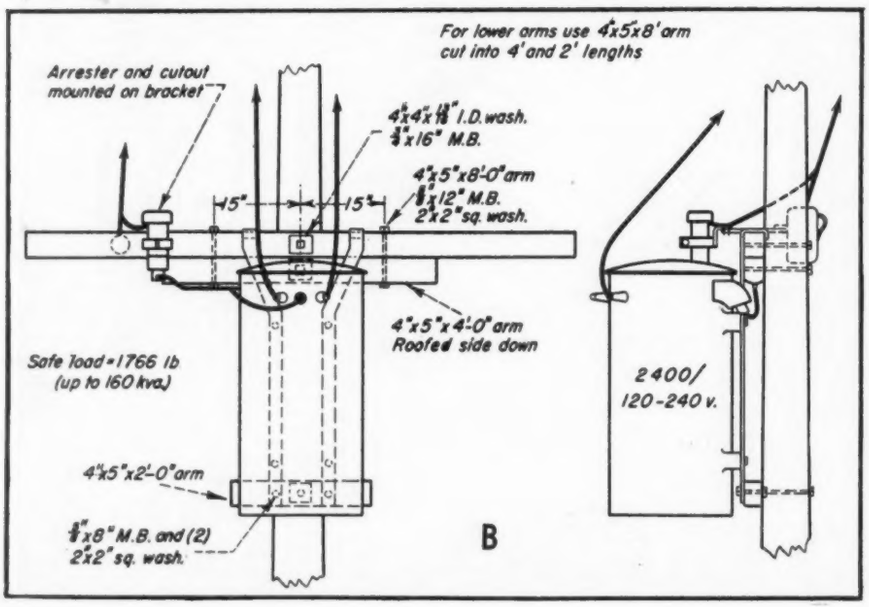
Compressive stress parallel to grain—psi.	800
Modulus of elasticity	1,600,000

Other Constants

Weight of 4 x 5-in. arm—lb./ft.	5.2
Moment of inertia 4 x 5-in. arm—in⁴	41.7
Section modulus 4 x 5-in. arm—in³	16.66



TRANSFORMER MOUNTING SCHEME uses "doubled" crossarms and hangers. Shown are: (A, above) mounting for up to three 15-kva. units; (B, below) mounting for up to 100-kva. single-phase units. Both use the "unbraced" crossarms



Using ¾-in. bolts, 4 x 5-in. crossarms, and a 40-ft. class-3 CYP pole, allowable loads were calculated to be as follows, considering the limiting strength of individual elements of the assembled structure:

1. Column loading of pole (at 27-ft. height)—lb.	1,680
2. Bearing of pole on soil (2T/sq. ft. allowable)—lb.	2,020
3. Bearing of through bolt on pole—lb. per bolt	1,200
4. Bending of through bolt—lb. per bolt	620
5. Bearing of through bolt on arm—lb. per bolt	720
6. Bending of arm—load 30 in. out—deflection 1/16 in.	232
7. Strength of wood brace—load 30 in. out—lb. per brace	500

Based on the above table the following safe loads have been derived for different arrangements of crossarms:

Single-Phase Installations

1—4 x 5-in. unbraced arm—557 lb.—Up to 15-kva. transformer (Includes 63 lb. for arms, L. A. and C. O.)

2—4 x 5-in. unbraced arms—1,167 lb.—Up to 37½-kva. transformer (Includes 73 lb. for arms, L. A. and C. O.)

3—4 x 5-in. unbraced arms—1,766 lb.—Up to 100-kva. transformer (Includes 94 lb. for arms, L. A. and C. O.)

Three-Phase Installations

2—4 x 5-in. unbraced arms—1,132 lb.—Up to 3 10-kva. transformers (Includes 108 lb. for arms and C. O.)

3—4 x 5-in. unbraced arms—1,710 lb.—Up to 3 15-kva. transformers (Includes 150 lb. for arms and C. O.)

3—4 x 5-in. braced arms—2,788 lb.—Up to 3 37½-kva. transformers (Includes 212 lb. for arms, braces and C. O.)

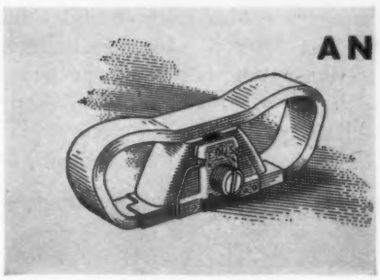
In the "unbraced" crossarm assemblies mentioned above the 28-in. steel braces are used as shown but only to hold the arms horizontal. When it is intended that the braces carry part of the load on a "braced" assembly, 60-inch wood braces are used.

The above transformer sizes are based on 1937 catalog weight for transformers and include hangers. Larger kva. sizes than those shown, of the newer types, may be safely mounted on any of the above combinations of arms. It should be remembered, however, that utility stocks include many

You can count on the

I-30

FOR MAGNETIC STABILITY



AND NO WONDER! At the heart of this meter is a G-E alnico magnet

This surge-resisting magnet owes its stability to (1) all-welded, one-piece construction, (2) careful control of material and dimensions at every step in manufacture, and (3) the inherently high coercive force of alnico. It helps make the I-30 a meter you can depend upon—a meter that maintains its excellent performance under increasing loads in both urban and rural service.

Include the I-30 in your metering program. It's the safe thing to do. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

WATTHOUR METERS

Headquarters for Electrical Measurement

GENERAL ELECTRIC

501-15-6116

older and heavier types such as those with cast iron bases, which require stronger support for the same kva. size. Further, if there is any likelihood of an increase in capacity of an installation in the near future it is economical to install a mounting strong enough to hold the next larger size.

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A Guide to Flameproof Textile Fabrics

A listing of chemicals and references for flameproofing materials has been outlined by American Mutual Liability Insurance Co., Boston, and is presented briefly here as a service for engineers, construction and operating personnel in the electrical industry.

Materials for flameproofing comprise various chemicals (usually containing water of crystallization or giving off a nonflammable gas when heated) and include items such as ammonium sulphate or phosphate, ammonium chloride, borax and boric acid. These chemicals, usually in saturated water solution, are applied to the fabric.

For a more detailed discussion of this subject, covering materials, methods of test and standards, bibliography and list of patents, reference can be made to a research report, "The Fireproofing of Textiles," published July, 1943, by the Textile Research Institute Inc., 10 East 40th St., New York City. There is also "Recommended Requirements for Flameproofing of Textiles," published in 1941 by National Fire Protective Association, 60 Batterymarch St., Boston, Mass.

Flameproofing materials may be purchased under their chemical names or as proprietary compounds.

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Improved System For Wetting Down Coal

H. E. MACOMBER
Engineer in Production Dept.
The Detroit Edison Co., Detroit, Mich.

Transfer of coal from self-unloading boats at plants of the Detroit Edison Co. has always been a dusty operation. Because it has been recognized by the company as a nuisance, a great deal of thought has been given to its suppression.

Up until recently, water was sprayed on the coal before it was dumped from the boat conveyor onto the dock pile. This has never been an entirely satisfactory solution. During the past year, however, a much more satisfactory method has been developed as a result of wetting down coal as it is transferred from rail cars to boats at Toledo, enroute to our plants.

The scheme as proposed requires about 2½ gal. of water (1 percent by weight) for each ton of coal loaded. To improve wetting efficiency of the water and to reduce the quantity required, a wetting agent (trade name 'Wetsol') is mixed with the water in the proportion of 1 gal. of agent to 200 gal. of water. Thus a cargo of 10,000 tons would be damped with about 100 tons of the mixture. This scheme was tried out on about 25 cargoes during the 1944 season. For 1945 all boat coal was so treated at Toledo. From experience, however, it has been found desirable to reduce the proportion of mixture added to about ⅔ of the amount specified above in order that an excess of water will not drain down through the cargo while in transit. This has necessarily made the wetting process less effective, but even so handling is essentially dust free during unloading onto the dock and subsequent transfer to stock piles at the plants.

In the power houses the handling, crushing and conveying of coal is also the cause of a dust problem insofar as it creates a dusty and dirty atmosphere for the operators whose job it is to look after the equipment. In most instances this problem has been met by the installation of an exhauster fan with a system of ducting and a cyclone separator or cloth filter. By "casing in" a source of dust, such as a coal breaker or points where coal may drop onto a conveyor, dust is fairly well confined. Then by connecting the casing or dust hood to ducting of the fan system, it is possible to produce an in-draft of air that carries away the dust to the cyclone for separation.

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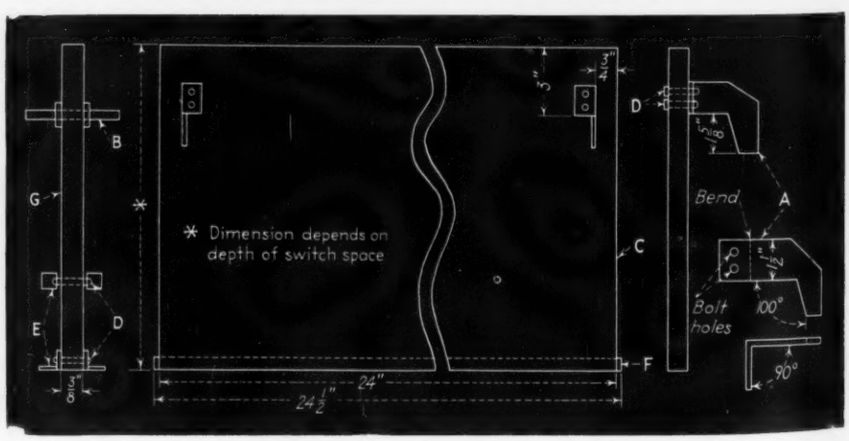
Hanger Designed For Door Support

WILLIAM K. HOLMES
Chief Electrician, Municipal Power Plant, Freeport, N. Y.

A method of supporting doors for disconnecting switches has been found to be quite satisfactory by the development of a specially designed hanger.

Referring to the illustration, the door C has bolted near each upper corner a hanger A which is supported by a stud B fastened in a barrier G and similarly supported at the adjacent barrier.

When the door is in place, the pieces of angle iron E bolted to the barrier at the upper location prevents the door entering the space between barriers. The pieces of angle iron E bolted at the lower end of the barrier are used for supporting a bottom enclosure F which slides horizontally between the barriers. This bottom piece serves further to protect anyone from coming in contact with the disconnect switches. The door C has been used on 30-in. as well as 24-in. widths.

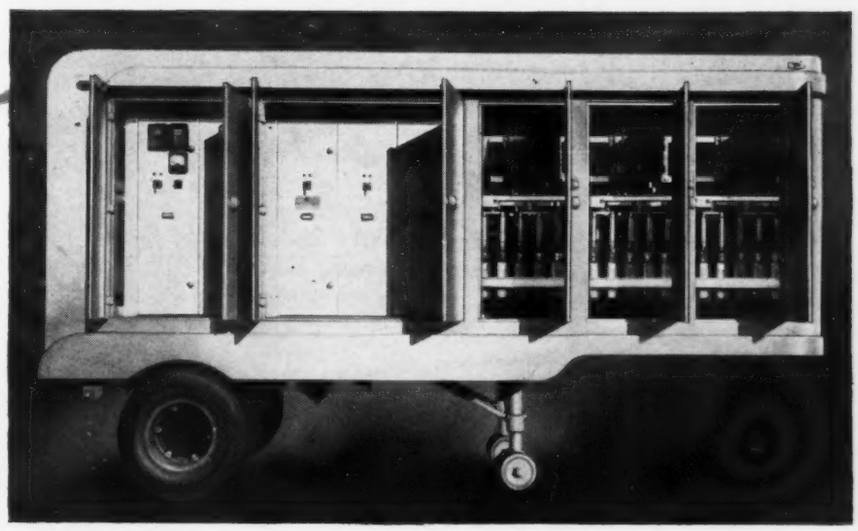


OUTLINE OF DOOR HANGER.

A = hanger, sheet iron, 0.065 in.
B = ⅜-in. x 3-in. stud, with locknut on each side.
C = door, ⅜-in. plywood or ebony.
D = ¼-in. bolts M.S.
E = 1-in. x 1-in. x 1-in. x ⅛-in. angle iron.
F = bottom enclosure, material same as door C.
G = barrier of ebony asbestos.

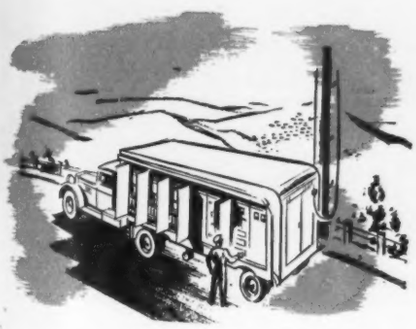
KILOVAR Canteen

New G-E Capacitor Trailer brings Kilovars Close to the Load!



With this capacitor-trailer, it is possible to pull up alongside the load and, with live-line clamps, connect in capacitors in sections of 180 kvar each to a total of 1080 kvar. The trailer is completely "self-contained" and includes one hand-operated magne-blast main breaker, and three magne-blast breakers which accomplish manual and automatic switching under load. Panel-mounted voltage and current meters are included for checking of capacitor results.

The equipment is rated 4160 volts, 3-phase wye, 60 cycles, 2400 volts delta. 72 individual capacitor units rated 15 kva, 2400 volts are arranged in racks. The use of highly stable, non-inflammable Pyranol capacitors together with magne-blast breakers eliminates the fire hazard. Built-in jacks enable quick leveling of the unit, and permit taking weight off tires if the unit is to stand for some time.



THIS new, complete, mobile capacitor equipment has recently been supplied by General Electric to the Consolidated Gas, Electric Light and Power Company of Baltimore.

The complete flexibility this unit affords will enable it to supply kilovars for emergency needs as well as to provide immediate voltage correction and power-factor improvement close to seasonal loads. In addition, its mobility permits it to be used as a capacitor laboratory on wheels for making full-scale tests on feeders to determine the needs for permanent capacitor installations.

So adaptable are capacitors in helping improve system load conditions that it is a logical step ahead for power companies to purchase equipments that can be moved from place to place. General Electric engineers will be glad to discuss with you the possible use of such equipment in your system. Write to *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

407-106-5700

HOW TO CONNECT TRANSFORMERS FOR USE AS VOLTAGE BOOSTERS

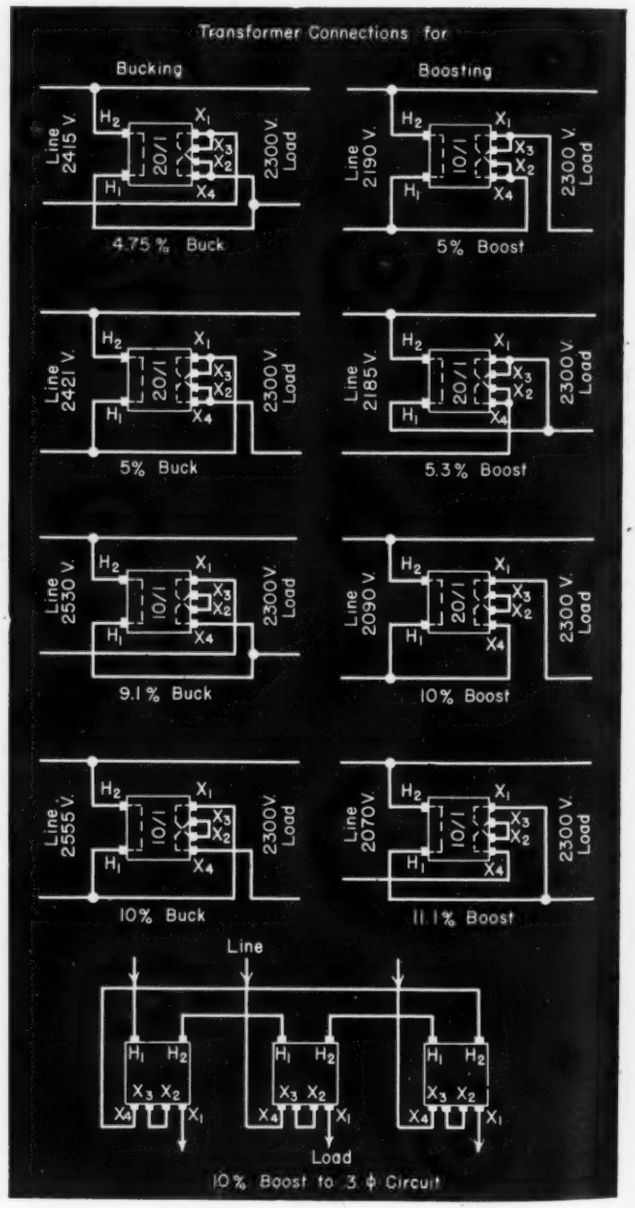
Accompanying discussion and several connections illustrating how various amounts of voltage boost or buck may be obtained from standard distribution transformers are adapted from the recently issued "Handbook for the Construction of Electrical Supply Lines" of Wisconsin Power & Light Co., Madison

STANDARD DISTRIBUTION TRANSFORMERS may be used to boost or buck the voltage of a supply. The ratio of transformation of the boosting or bucking transformer determines the amount of change in voltage. Rating of the high-voltage winding must correspond to that of the line. Since all windings are subjected to line voltage, a transformer having sufficient insulation to withstand the line voltage between the low-voltage winding and ground is required, and the case may be grounded.

To determine the capacity in kva. of a transformer used for boosting or bucking, first find the load in amperes on the line to be corrected, then select a transformer whose low-voltage winding is sufficiently heavy to carry the load on the line. For example; suppose a 2,400-volt, single-phase line is to have its voltage boosted 10 percent and the maximum load is 20 amp. A transformer with a 2,400-volt, high-voltage winding and a ratio of 10:1, (a 240-volt, low-voltage winding) having a capacity of 240 x 20 or 4,800 watts or 5 kva. would be required. If a 5 percent boost or buck was sufficient, then a transformer with a ratio of 20:1 would be required. This is accomplished by connecting the low-voltage windings in multiple for 120 volts. The capacity required would then be 2,400 watts, say 3 kva.

Certain precautions are necessary in the operation of booster or bucking transformers. The most important is that the primary or high-voltage leads to the transformer must *never* be opened while the low-voltage or secondary is energized. To do this would produce a voltage several times normal in the high-voltage winding. Should there be any question about the sufficiency of insulation in the low-voltage winding, then the case should be insulated from ground and isolated or guarded from possible contact with linemen. If the case of the transformer is not grounded, it should be regarded as "hot."

The accompanying sketches illustrate connections for transformers used for raising or lowering the voltage of a line. Change in voltage shown disregards loss in the transformers.



IN THE PUBLIC'S INTEREST—
but not in its eye

HERE are the successors to the radial-wave reflector—two new G-E suburban reflectors that now bring scientific light distribution to the lighting of residential streets. Light formerly dissipated in non-useful directions is utilized to better advantage. Direct glare is greatly reduced. Uniformity of illumination on the road is much improved, yet installation and maintenance are easy.

Two types—open and enclosed—using series lamps of 1000- or 2500-lumen rating are available with adapters to fit practically any fixture that takes the standard-dome radial-wave reflector. They may be installed either as unit-for-unit replacements to provide better light distribution, or in accordance with I.E.S. Recommended Practice to obtain specified illumination levels at low cost.

These G-E suburban reflectors offer utilities an inexpensive way to improve suburban lighting in their communities and to keep that lighting at high efficiency for years of low-cost service. Why not check the features listed here, then ask your local G-E representative how these reflectors can fit into your suburban streetlighting plans? *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

SCIENTIFIC LIGHT CONTROL

A highly efficient light distribution pattern effectively utilizes much of the light ordinarily wasted in producing objectionable glare and illumination of house fronts.

HIGHER LIGHTING LEVELS

When equipped with the new G-E 2500-lumen lamp of 5 3/8-inch light-center length and spaced as recommended, I.E.S. Standards for suburban lighting can be readily met.

USE TWO WAYS

1) *In existing installations* as unit-for-unit replacements for radial-wave reflectors.

2) *In new installations* to provide higher lighting efficiency and more uniform illumination.

LOW MAINTENANCE COST

Alzak-processed aluminum reflectors retain high efficiency for years under all weather conditions, and are easily cleaned when necessary. Enclosed type has refractor spun-sealed to keep out dirt and to practically eliminate breakage.

(a) Form 79 CR luminaire with enclosed suburban reflector. Simple latches and safety chain facilitate relamping.

(b) Form 45 L luminaire with open suburban reflector. Either one or two shields may be easily attached if needed.

Are you tieing in with the NEMA plan to give America better street lighting?

Good Street Lighting
BUILDS GOOD WILL

STREET LIGHTS *for better seeing*

GENERAL ELECTRIC

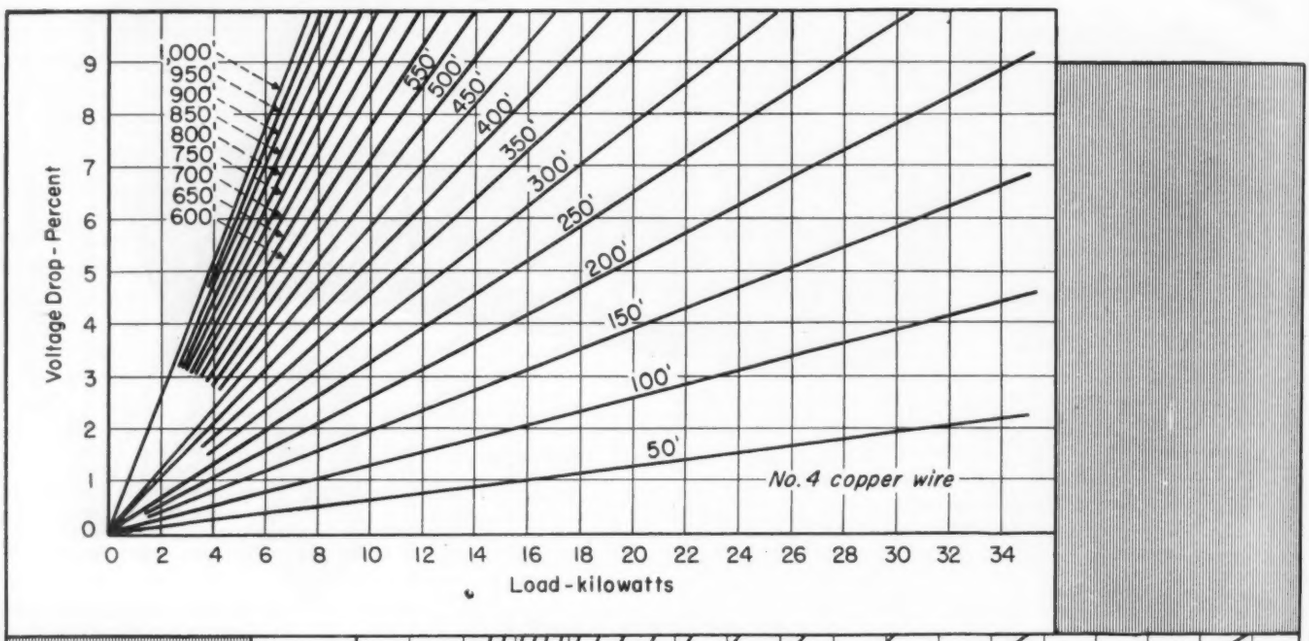
452-39-3010

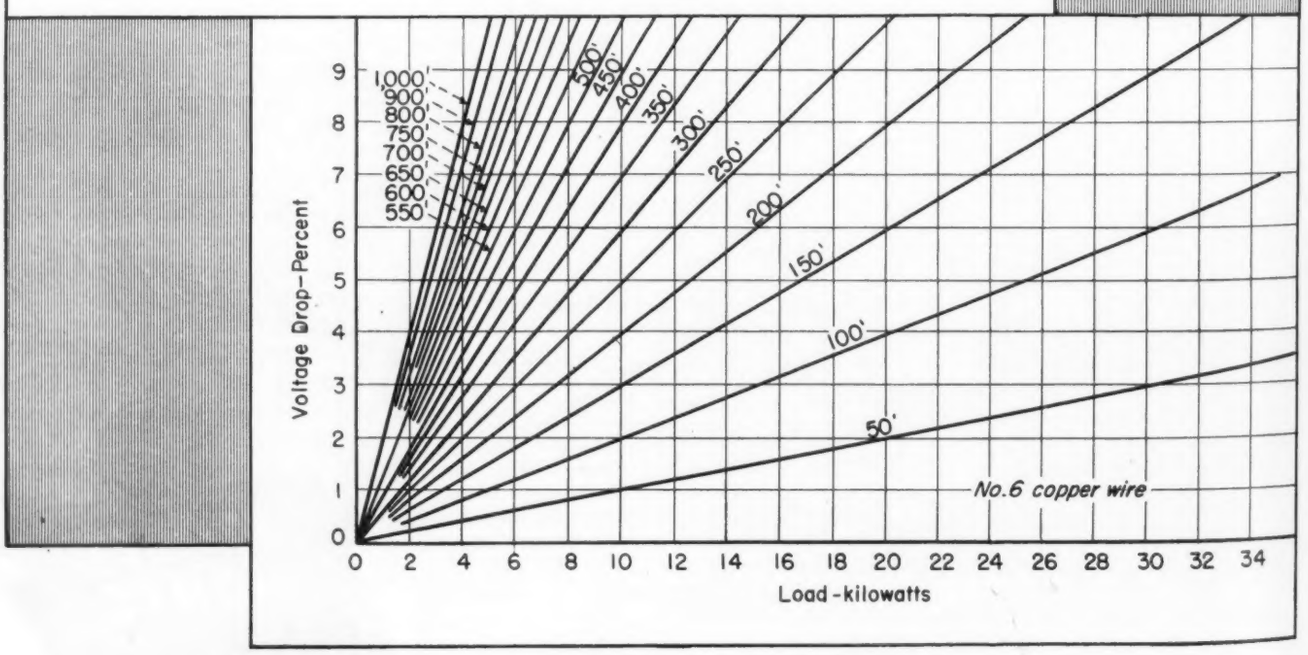
VOLTAGE DROP ON SECONDARY CIRCUITS WITH UNBALANCED CONDITION—I*

(No. 4 and No. 6 Bare Copper)

Curves give percent voltage drop for loads up to 35 kw. and for distances up to 1,000 ft. Circuit characteristics are: Bare solid copper conductors as indicated on the respective charts, 230 volts, 95 percent power factor, 15 percent unbalance, single-phase, 8-in. spacing.

PAGE W. CHOATE, Senior Engineer, Carolina Power & Light Co., Southern Pines, N. C.



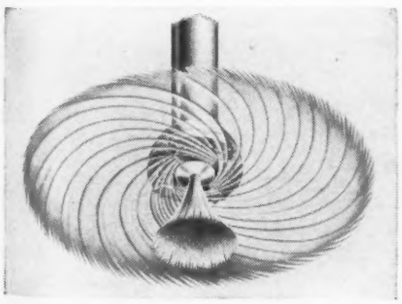


* Similar curves for No. 2, 1/0, 2/0, and 4/0 copper wire will be published in subsequent issues.

NOZZLE-SWIRL ADDS TO CABLE LIFE

8 YEARS OF SERVICE CONFIRMS LONG-LIVED PROTECTION OF OXIDE-FREE LEAD SHEATH

More than eight years ago General Electric developed the nozzle-swirl process of applying lead sheathing to its paper-insulated cable. G-E cable, lead-sheathed by this process, found immediate acceptance. Today, eight years of service experience with this cable is giving convincing evidence that the G-E "nozzle-swirl" process adds years to cable life. In these installations, cable faults and signs of sheath weakness have been brought to a new low; trouble caused by oxidized lead in the sheathing no longer occurs.



Lead is forced through bottom hole and swirled by blades, assuring oxide-free fusion with old charge.

THE NOZZLE-SWIRL PROCESS

The presence of occluded oxides is the greatest single factor in the failure of lead sheathing of cable. When such oxides are trapped in the lead sheath, flow lines and laminations cause weak areas.

These oxides normally originate in the charging cylinder of the lead extrusion press, the surface coat of oxide on the old charge being trapped under the new charge.

The nozzle-swirl process, as shown in diagrams (right), employs a filling-spout nozzle of special design, and the injection of inert gas, to scour oxides from the junction of old and new charges. The two fuse completely, so that a homogenous mass is fed to the die block which forms the sheath around the cable.

UNIFORMITY ASSURED

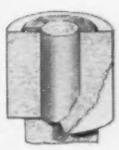
This produces a lead sheath with no flaws to cause failure. G-E lead-sheathed cable is uniform in every foot of its length. There are no hidden weak spots to show up when power load variations put pressure on the sheath.

When you order G-E lead-sheathed cable, you get the only cable with this extra assurance of maximum cable life. For complete information on what it can mean in savings to you, check with your local G-E representative or ask for Bulletin GEA-2968. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

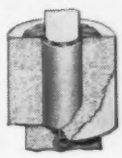
HOW SHEATH-LEAD IS KEPT OXIDE-FREE WHEN CHARGE IS ADDED

New molten lead from the special nozzle has already penetrated into the old charge. The swirling lead takes the oxides up and away from junction and shim.

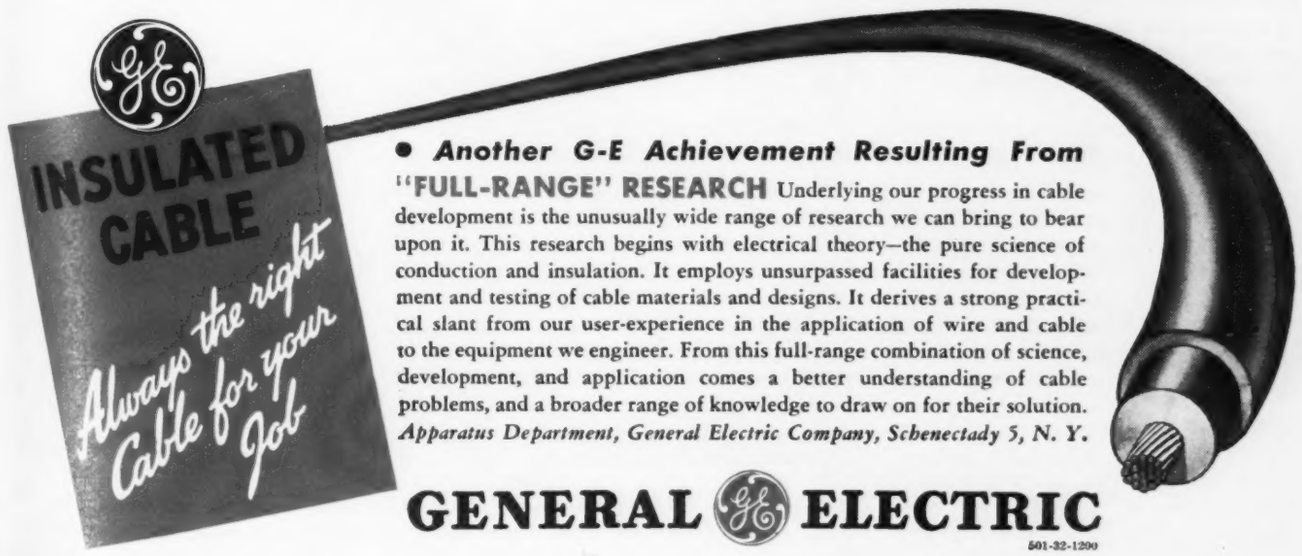
The lead continues to swirl, removing the entire shim, pulling all oxides to the center, and uniting them in a ball. The new charge has now completely fused with the old charge.



The cylinder is filled, and the top of the charge containing the oxides has overflowed. The ball of oxides has been removed and the surface has been skimmed.



The lead is now solidifying and the ram has begun "packing" the charge. When the lead has been cooled, the ram will force the semiplastic mass through the die block, thus forming the sheath around the cable core.



● ***Another G-E Achievement Resulting From "FULL-RANGE" RESEARCH*** Underlying our progress in cable development is the unusually wide range of research we can bring to bear upon it. This research begins with electrical theory—the pure science of conduction and insulation. It employs unsurpassed facilities for development and testing of cable materials and designs. It derives a strong practical slant from our user-experience in the application of wire and cable to the equipment we engineer. From this full-range combination of science, development, and application comes a better understanding of cable problems, and a broader range of knowledge to draw on for their solution. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

501-32-1200

A METHOD FOR TERMINATING AND TAPPING COAXIAL AND SHIELDED CABLE

Sequential operations, outlined and illustrated, in a procedure for making coaxial and shielded cable ground tap and terminal connection.

I. MATTHYSSE, Chief Design Engineer, Burndy Engineering Co., New York, N. Y.

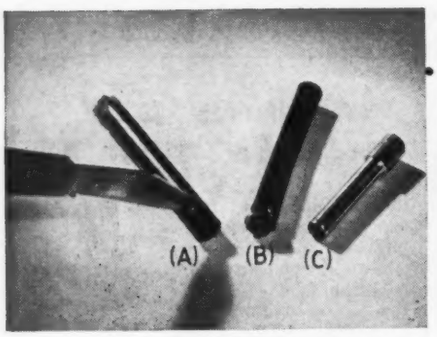


FIG. 1—(A) For the first step in the procedure, the outer insulation of cable is to be cut and stripped to bare ¼ in. of the outer conductor or shield. (B) The outer conductor is then splayed to facilitate entrance of stripper-aid tool shown at (C)

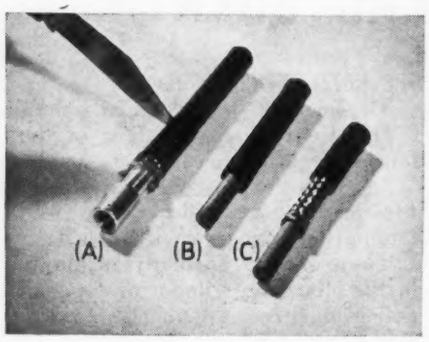


FIG. 2—(A) Stripper-aid tool is inserted beneath outer conductor which is stripped along with outer insulation just before end of bulge to expose inner insulation (B). (C) From ½ in. to ¾ in. of outer insulation is then stripped to bare outer conductor

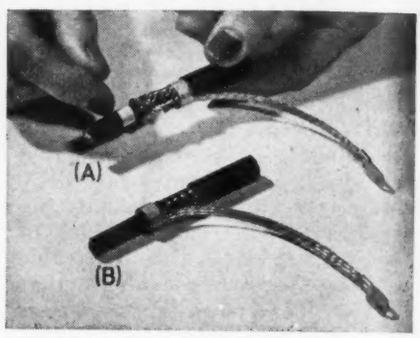


FIG. 3—(A) Large ferrule has been slipped over end of outer conductor and end of jumper tap, and small ferrule is being pushed beneath outer conductor. (B) Then both ferrules and end of jumper tap are lined up with end of outer conductor

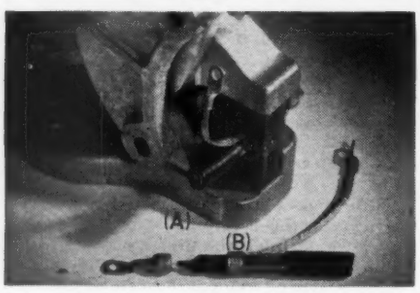


FIG. 4—(A) Assembly shown in Fig. 3 is being indented in a foot-operated tool. The circumferential indentations made by the interlocking dies of this tool can be seen at (B), which shows the inner conductor bared to receive the terminal

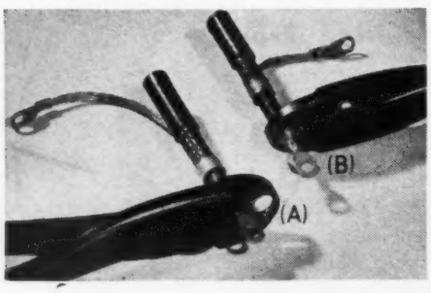


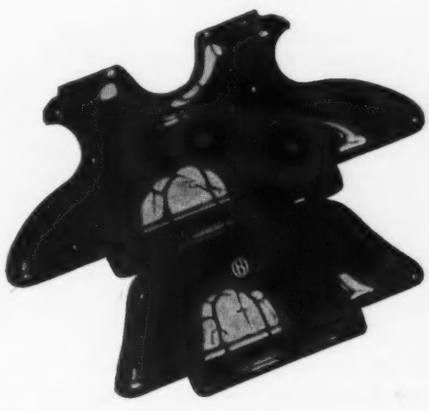
FIG. 5—(A) Terminal is being indented to the inner conductor with a manually operated tool. (B) Using the forward die of this same tool, the shroud on the terminal is then crimped to the inner insulation

FIG. 6—Here is the completed coaxial and shielded cable ground tap and terminal connection. The tap sleeve may also be used merely as an anchor to prevent the braid slipping

time when you know

Good it is

This old Grandfather's Clock tells us something important about insulators... When the clock was new it looked much like hundreds of others. Its buyer probably asked, "How good is it". But, there finally comes a time when you forget this question. You know!... It's the same with insulators. They look alike. They specify alike. They test alike. They *are* pretty much alike--*when new!* But they don't stay new. The important quality of an insulator is its ability to retain satisfactory operating values for an indefinite time... An O-B insulator offers nothing in distinctive looks, in trick design, in surplus test values. It does nothing special for the first year; maybe the first ten years. It's basic qualities don't show up quickly. But when you use O-B insulation there finally comes a time when you forget the question, "How good is it?". You *know!*



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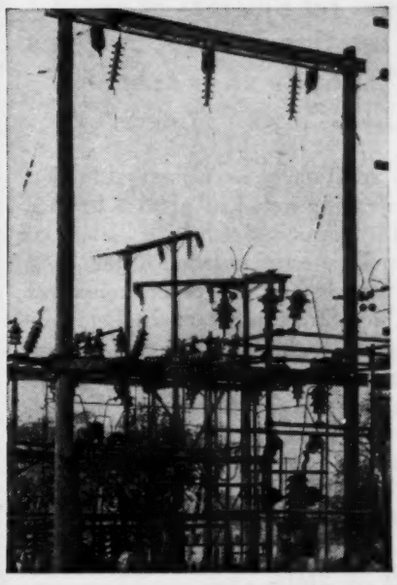
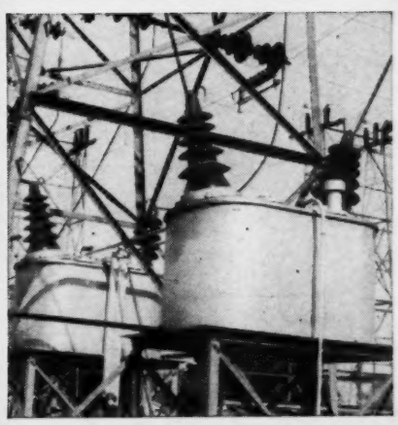


A strange place for pintypes? Not so strange when we consider that these O-B pintypes were modified for station use in a day before special designs were fully accepted. This station is now serving the power requirements of a large railroad division center; just like it has for longer than 25 years.



Thirty-three years ago, these O-B bushings went into service on 110-Kv. They were later modernized when compound filling was replaced with oil. Otherwise, they have rolled up these years without special attention or any type of electrical or mechanical trouble.

Steam Jet Ejector Has Many Functions

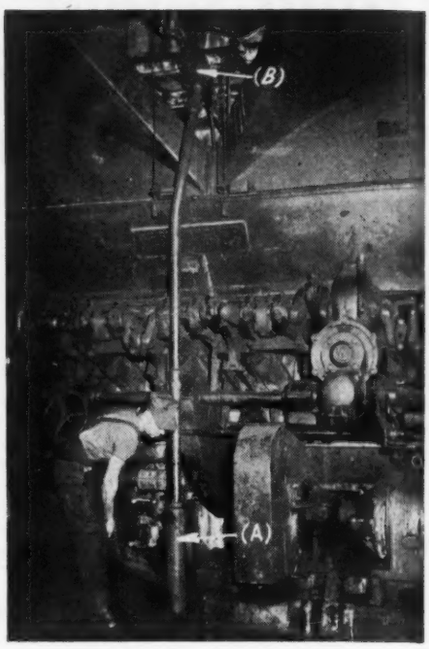
GEORGE SPANGLER
Chief Engineer, Harding Street Plant
Indianapolis Power & Light Co., Ind.

In addition to its primary function of supplying over-fire air to a furnace fired by an underfeed stoker, a special steam jet ejector installed in the front wall of one of the older boilers at Harding Street plant of Indianapolis Power & Light Co. performs several other functions. It can be used, for example: (1) To inject into the furnace coal fines that have dropped from the stoker rams onto the firing floor; (2) to burn fuel oil in the furnace occasionally, and (3) to inject coal into the furnace from a sifting hopper under the grate.

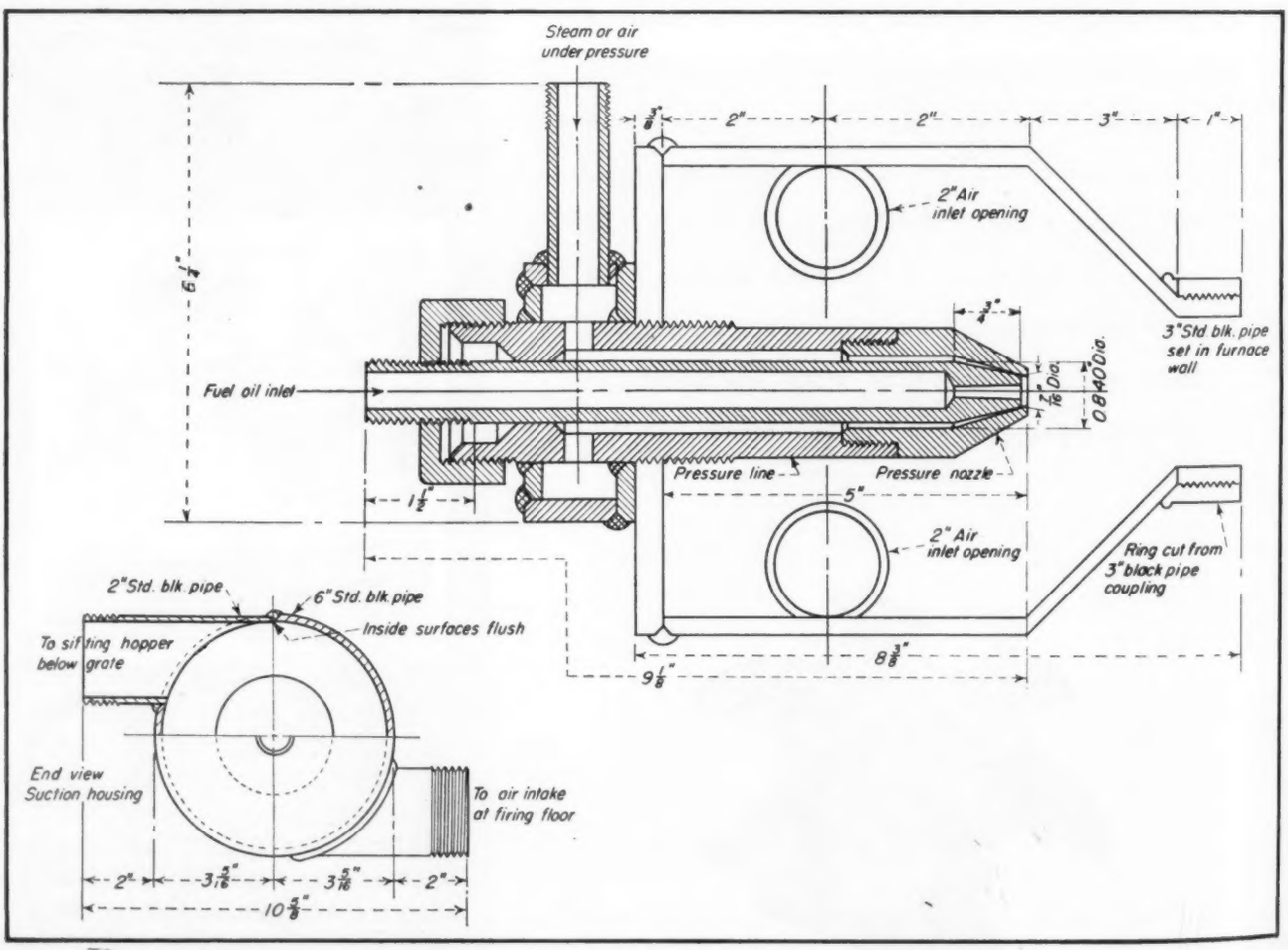
Design and arrangement of the jet ejector is shown as it is now arranged for performing these varied functions. For injecting coal and air into the furnace, steam, under a pressure of 150 psi., is used as the actuating fluid in the ejector. Used as a burner for firing fuel oil, air under similar pressure actuates the jet. In either case high velocity is imparted to the actuating fluid in a special annular pressure nozzle that surrounds the tube supplying oil to be fired. On the other hand, air or coal to be injected into the furnace is drawn by the action of the high speed jet into a conical suction housing that *surrounds* the ejector nozzle. Two inlets are provided in this suction housing; one inlet pipe leads to the firing floor level and the other to a "sifting hopper" below the furnace grate. Action of the jet produces a negative air pressure of 6 in. in these inlet pipes.

With the ejector operating to supply over-fire air, and with no change in damper position or rate of coal feed, it is possible, when over-fire air is needed, to increase the output of the boiler from 120,000 to as much as 126,000 lb. of steam per hour.

Air for the ejector is drawn from the level of the firing floor through a 2-in. pipe. The concrete firing floor has been chipped away immediately below the lower end of the suction pipe to form a conical depression. Into this depression coal "fines" that drop



EJECTOR AT WORK injecting coal siftings from boiler firing floor into furnace. Suction line (A) from ejector housing (B) terminates in a conical depression in firing floor. Coal or chemicals placed in the depression are sucked up with overfire air and injected into furnace


Steam or air under pressure
2" Air inlet opening
3" Std. blk. pipe set in furnace wall
Fuel oil inlet
Pressure line
Pressure nozzle
2" Air inlet opening
Ring cut from 3" black pipe coupling
2" Std. blk. pipe
6" Std. blk. pipe
Inside surfaces flush
To sifting hopper below grate
End view Suction housing
To air intake at firing floor

DESIGN DETAILS of steam-air jet ejector used for injecting air, fuel oil, coal or chemicals into boiler furnaces

to relight America!

For the new world ahead there will be Westinghouse Lamps in abundant measure . . . lamps to shine in every conceivable requirement of lighting!

In 1946 Westinghouse will continue, to the best of its abilities, to produce in increasing volume bright, long lasting incandescent bulbs . . . fluorescents . . . circlines . . . slim lines . . . lamps for industry and commerce . . . for homes and schools . . . all built to rigidly controlled, famed Westinghouse quality standards.

AND HERE ARE TWO OF MANY AIDS TO YOUR RELIGHTING PROGRAM!

Westinghouse Lamp Division promotions of better lighting will keep pace in the coming year with new Westinghouse developments in lamp research and engineering. These promotions will be designed to help lighting companies in interesting their residential, commercial and industrial customers in the *practical* values of better lighting. Following are two of many ways in which Westinghouse promotions will work for you in 1946.

The new Westinghouse See-ability Meter . . . simplified readings make it easier for Home Lighting Consultants to discuss Relighting with their prospects!

The new Westinghouse Lighting Training Course for utility personnel—"Illumination . . . Fundamentals and Application", is a complete, easily taught and easily understood program. Comes complete with 18 Soundslide Films and 18 Lesson Books.

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Westinghouse Lamps

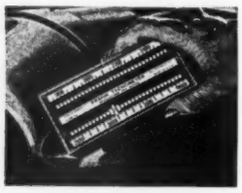
PLANTS IN 25 CITIES OFFICES EVERYWHERE

FOR EVERY LIGHTING REQUIREMENT

Look to BIDDLE . . .

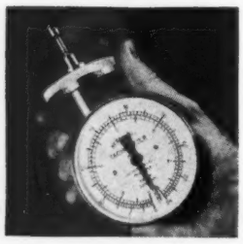
For Precision Instruments FOR MEASURING SPEED

Over the past 30 years we have been a source of supply for precision speed measuring instruments that have consistently demonstrated their superior quality, high accuracy and dependability in service. We now offer a variety of types and ranges of instruments for measuring rotational and surface speeds, and rates of vibration. We believe they will be helpful in the solution of some of your engineering problems. The following are typical:



The FRAHM VIBRATING REED TACHOMETER *requires no contact with the rotating element and is unique for measuring speed of totally enclosed machines and other equipment where the end of the shaft is not accessible. The only mechanism is a set of accurately tuned steel reeds which vibrate by resonance according to the speed of the machine on which the instrument is held. For hand use in servicing, installation and maintenance work; also built in types for permanent mounting. Various ranges available from 900 up to 100,000 rpm. Used also and in the same way for measuring rates of vibration.*

Write for descriptive Bulletin 1590-W.



JAGABI PRECISION HAND TACHOMETER. *Five ranges in one instrument. Simply rotate the barrel head to change to any one of the five ranges—60-240, 200-800, 600-2400, 2000-8000, 6000-24000 rpm. Measures rpm and fpm by direct pointer deflection . . . fly-ball governor principle . . . large, easy-reading dial with two scales nearly 6½" long. . . . Accurate to within one scale division. . . . Independent of direction of rotation. . . . Supplied complete with case and accessories.*

Write for descriptive Bulletin 1800-W.

JAGABI HAND TACHOSCOPE. *A combined speed counter and stop watch with synchronized start and stop mechanism for measuring average speeds and constant rates of speed to a high degree of accuracy. Used for routine tests as well as for checking other speed-measuring instruments up to 20,000 rpm. Can be used also for measuring linear or peripheral speeds. Stop watch can be used independently. Supplied complete with case and accessories.*

Write for descriptive Bulletin 1790-W.

The JAGABI SPEED INDICATOR *is a watch size speed measuring device which adds up the number of revolutions over a period of three (or six) seconds and shows the revolutions per minute without any calculations. Can also be used to measure feet per minute. Available in two models—for low speeds up to 2000 rpm and for all speeds up to 20,000 rpm. Accuracy well within one-half of one per cent.*

JAGABI HI-SPEED INDICATOR (*not shown*). *Chronometric type designed for extraordinarily high speeds, operating on the same principle as the Jagabi Speed Indicator. For speeds up to 100,000 rpm.*

Write for descriptive Bulletin 1505-W.

JAMES G. BIDDLE CO. • **1316 ARCH STREET PHILADELPHIA 7, PA.**

down from the stoker rams are swept or shoveled. In this way they are sucked up with the air and injected into the furnace. Chemicals for furnace treatment can be injected in a like manner.

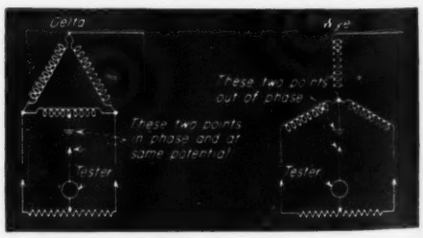
The second inlet pipe to the suction housing of the ejector leads originates in the sifting hopper below the furnace grate where coal fines that drop through the grate are collected. Ejector suction picks up fines from hopper, which were formerly thrown out with furnace ash, and fires them in the furnace. An air pressure line is provided in the sifting hopper to loosen any coal that might pack around the suction opening and prevent its operation. It is estimated that 1,000 lb. of coal fines a day, formerly thrown out, are being recovered from the sifting hopper by the ejector.

The ejector may also be used as an oil burner. By using air as the actuating fluid in the ejector with fuel oil, it becomes a burner that may be used to start a coal fire on the grate directly without opening the furnace and building a wood fire first. Less delay in getting a boiler on the line is the result.

•

Tester Distinguishes 120/240 and 120/208 Volts

In power survey work there are many times when it is not possible to determine with a conventional voltage tester whether the service is 120/240 or 120/208. If the three hot legs are accessible, a test to the grounded neutral from each will indicate whether the service is delta or wye, but if only two hot legs and neutral are available for test the conventional type of tester is not sufficiently sensitive and it is necessary to call again with a voltmeter. A voltmeter is too bulky and fragile to carry at all times.



WIRING diagrams showing principle of operation of neon lamp voltage tester

A simple vestpocket tester for use in such cases has been made up by H. O. White, Pacific Gas and Electric Co., San Francisco, who submitted it as a

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COMMERCIAL LUMINAIRES

Broadens Your Lighting Service! Fills Today's Need for Modern Beauty and Higher Levels of Illumination

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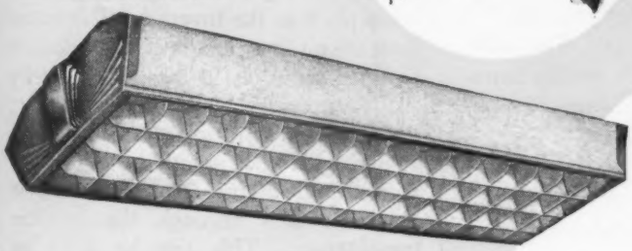
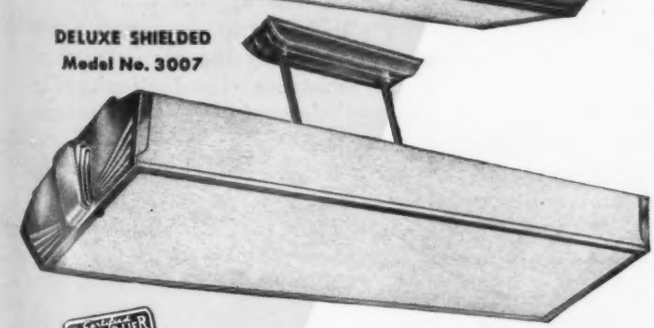
DELUXE LOUVERED
Model No. 3011



SHIELDED UNIT
Model No. 3004

DELUXE SHIELDED
Model No. 3007



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You have *everything* in the new complete MITCHELL line . . . to help you render a broader, more complete lighting service. For MITCHELL Fluorescent Luminaires offer every aid to lighting beauty and effectiveness . . . and more value per dollar. Twelve important features include exciting new modern designs in 2-light and 4-light units . . . glass-shielded, louvered and open types . . . Instant-Start . . . new patented "One-Man Quick Mount" . . . economical maintenance. Back of it all, stands the nation-wide acceptance of MITCHELL Products.

Get New Catalog No. 285
Illustrates and describes the complete line of Commercial Luminaires. Includes helpful lighting data and servicing information. Write for it now.

See Our Catalog in Sweet's
For convenient reference, Mitchell Commercial and Industrial units are cataloged in Sweet's 1946 Architectural and Mechanical Industries Files.

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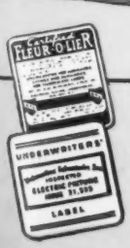
2525 CLYBOURN AVENUE, CHICAGO 14, ILLINOIS
West Coast Factory and Sales Office: 1019 N. Madison Ave., Los Angeles 27, Cal.

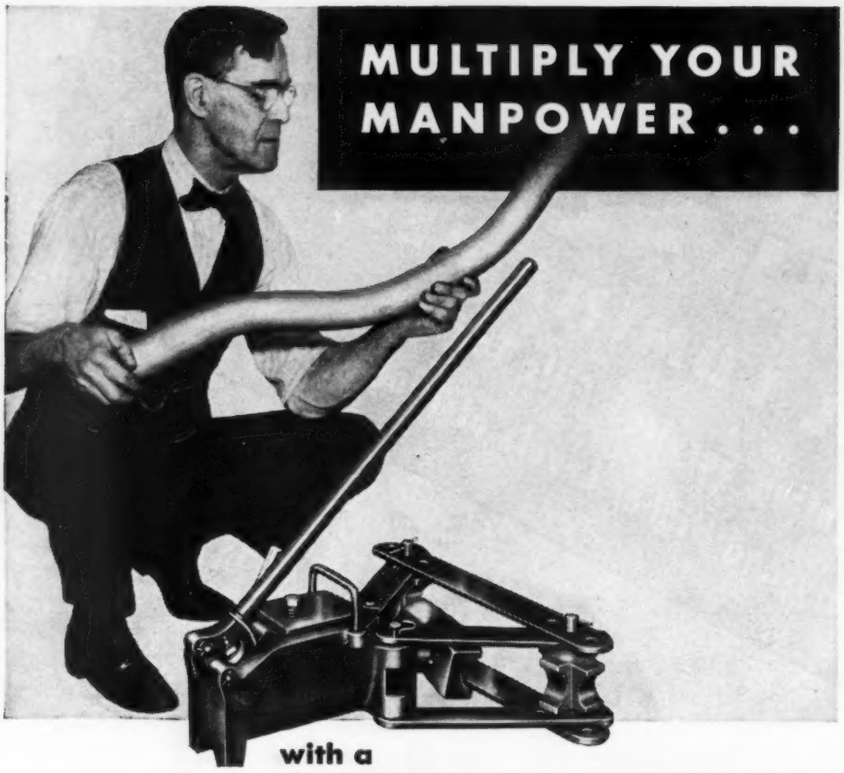


Visit the MITCHELL exhibit at the International Lighting Exposition at the Stevens Hotel, Chicago April 25-30, Booths No. 69, 70 and 71.

MITCHELL
FOR TOP LIGHTING VALUE

MAKERS OF

Commercial and Industrial Fluorescent Lighting Equipment • Store Window Lighting • Spotlights and Floodlights • Desk Lamps • Portable Floor and Table Lamps • Bed Lamps • Ultraviolet and Infrared Health Lamps • Residential Lighting Specialties.



with a

GREENLEE BENDER

"With our GREENLEE Hydraulic Pipe Bender a three-hour hand job on conduit (even using fittings instead of bends) is reduced to 20 minutes," says E. W. Willis, Vice President, Clark & Mills Electric Co., Boston.

When you can set up the GREENLEE Bender, make four accurate, smooth bends for a "saddle" as shown above, in a third of an hour . . . and save the cost of four fittings . . . you make tremendous savings.

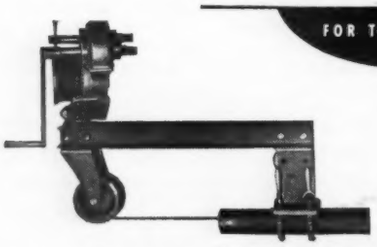
And further, you save greatly by cutting material spoilage to the minimum. For example, electrician C. E. Gage of the above firm reports, "Never spoiled a pipe in three year's use of the GREENLEE and we wasted plenty by getting kinks before."

Enjoy the extra time and material savings provided by the GREENLEE Bender . . . *one-man operated* for bending pipe up to 4 ½", rigid and *thin-wall* conduit, tubing, bus-bars. Rugged, compact, portable . . . easy to transport, set up and operate. Write for complete information today. Greenlee Tool Co., Division of Greenlee Bros. & Co., 1804 Columbia Avenue, Rockford, Illinois, U. S. A.

REGISTERED TOOLS

GREENLEE

FOR THE CRAFTSMAN



GREENLEE CABLE PULLER

Simple, compact unit exerts 7500 lbs. maximum pull, has two speeds through direct and back gears. Fastens direct to conduit — allows pulling in line with conduit, prevents hanger loosening. Flexible elbow attachment for pulling from concealed conduit.

OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK

Hand Benders • Joist Borers • Radio Chassis Punches • Knockout Tools • Pipe Pushers

suggestion under the employee's suggestion plan. It consists of a 25-watt, 4,000-ohm center-tapped resistor and a ¼-watt, 120-volt neon lamp, and has three short leads. If the two ends of the resistor are clipped to the two hot legs of a 240-volt single-phase service supplied from a delta-connected transformer bank, the light in series with the center tap will not light to ground, since the two points are at the same potential and are in-phase. If the resistor is clipped onto two hot legs of a 208-volt, open-wye service the lamp will light as there is a potential of approximately 60 volts to ground or neutral, as illustrated,

$$\left(V = \sqrt{120^2 - \left(\frac{208}{2}\right)^2} = 60 \text{ approx.}\right)$$

A number of testers with identical circuit but much bulkier have been in use by the East Bay Division of PG&E for several years, attesting to their usefulness and practicability.

•

How the Inverter Transfers D.C. Power*

R. W. HOLMAN
Carnegie-Illinois Steel Corp., Gary, Ind.

It is commonly considered impossible to transfer d.c. power through a transformer, yet this is actually what takes place in the inverter. The transformer on an a.c. system operates from the changes in flux produced by the reversals of the alternating current; therefore, in the inverter the direct current must be altered in some way in order that it shall tend to cause power to flow through the inverter transformer. This can be done by breaking the direct current up into pulses of current.

If a pulse of current were allowed to flow through one phase of the d.c. windings to the cathode, while the induced voltage from the a.c. system in that phase winding is in the same direction as the applied d.c. voltage, there would be two sources of power in series, forcing the current around a low resistance closed circuit (Fig. 2) consisting of the rectifier tank, rectifier transformer, inverter tank and inverter transformer, doing no useful work and probably some harm. As a matter of fact, this is what takes place when an arc-through occurs.

On the other hand, if the direct current is forced to flow in one phase of

* See the article "Mercury Arc Frequency Changer Limits Rolling Mill Demand" on page 112 of this issue.

STYRON

DOW POLYSTYRENE

THE NAME YOU CAN DEPEND ON IN PLASTICS

rated no. 1 in refrigerators

Add up Styron's properties! You'll find the reasons why this Dow plastic is a material of unique value to the refrigeration and many other electrical manufacturing industries.

Styron's dielectric qualities are outstanding. It has high resistance to acids and alkalies. It is extremely low in water absorption. And it has good dimensional stability, even at low temperatures. Styron is available in a range of colors from crystal transparent to the densest opaques. It produces extremely hard, brilliant and smooth surfaces. And Styron's light weight means more moldings per pound.

Consider Styron's properties and low price. They're the reasons why Styron is rated No. 1 in refrigerators, and for many other products. The combination portends better products, greater manufacturing economy for *you*.

let's work it out together

Success in plastics is best measured in end products. It calls for the combined efforts of manufacturers, designers, fabricators and raw material producers. Dow is ready to do its part. Call on Dow and get the most out of plastics.

PRESENT AND POTENTIAL USES: Lighting fixtures; insulators, battery cases; hydrometers; funnels; closures; food handling equipment; pharmaceutical, cosmetic and jewelry containers; costume jewelry; novelties; refrigerator parts; pens; pencils; liquor dispensers; escutcheons; chemical apparatus; dishes; lenses; decorative objects, trim.

PROPERTIES AND ADVANTAGES: Clear, translucent or opaque; broad color range; excellent high frequency electrical insulator; can "pipe" light through curved rod, and around corners; resistant to acids and many alkalies; low water absorption; light weight; stable at low temperatures; limited solvent resistance; available only in rigid forms.

DOW

PLASTICS

ETHOCEL • ETHOCEL SHEETING

STYRON • SARAN • SARAN FILM

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN • New York, Boston, Philadelphia, Washington, Cleveland, Detroit, Chicago, St. Louis, Houston, San Francisco, Los Angeles, Seattle

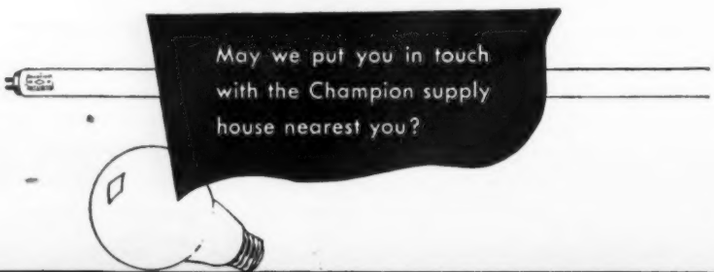
Buy CHAMPION Lamps

FROM YOUR LOCAL SUPPLY HOUSE AND GET THESE EXTRA ADVANTAGES AND SAVINGS

1 **Champion Quality.** Champion Fluorescent and *Incandescent* Lamps are designed, manufactured and tested for industrial service, and guaranteed to *equal or exceed* Federal Specifications. Your supplier cheerfully stakes his claim for your lamp replacement business on Champion Lamp performance in your plant.

2 **Champion Economy.** Champion Lamps get to you at lowest possible cost. The Champion organization, one of the largest and strongest in the lamp industry, concentrates on industrial lamps and industrial distribution at minimum cost and overhead. *You* are assured minimum light and lamp cost.

3 **Champion Industrial Distribution** has been carefully developed through qualified local suppliers who know your needs and are in constant touch with you. There's no better, more efficient or more economical way to buy lamps.



CHAMPION LAMP WORKS

Lynn, Massachusetts

A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO

an inverter-transformer d.c. winding while it is opposed by the induced voltage from the a.c. system in that particular phase winding, its energy is transferred through the transformer windings and power is transferred to the 60-cycle system. The inverter tank, therefore, must act as an automatic switch or commutator to direct the pulses of direct current with proper timing into those secondary windings where such pulses of direct current will be opposed for the greater part of their duration by an a.c. voltage from the 60-cycle system.

Inversion Function

Power inversion may also be explained by comparing rectifier operation with inverter operation. In a power rectifier used for transferring power from an a.c. system to a d.c. circuit, pulses of current flow successively through anodes and their associated phases of the transformer d.c. winding during parts of the cycle when the phase voltage is in the same direction as the current. If the current pulses were made to flow during parts of the cycle when the phase voltage is in the opposite direction from the current, the direction of power flow would be reversed. That is what is taking place in the inverter circuit.

D.c. voltage from the rectifier forces pulses of current to flow through successive anodes and transformer phases of the inverter during the part of the cycle when the phase voltage is negative in relation to the direction of anode current. Power is thus made to flow from the d.c. circuit into the a.c. system. This mode of operation is made possible by the control action of the inverter grids which keep each anode blocked during that part of the cycle when its phase voltage is positive, and permits it to fire and carry a pulse of the direct current when the phase voltage is negative.

An inverter fault or arc-through occurs when the blocking action of a grid fails and the anode conducts when its phase voltage is positive. When this occurs the inverter anode voltage is additive to the rectifier d.c. voltage, resulting in a short circuit.

The mercury arc inverter can only furnish power to a system with generating capacity connected and operating because the inverter draws excitation or lagging power factor current from the system to which it is furnishing power.

While it's very seldom that an overhead line is buried under tons of earth and rock as this one was, yet it's comforting to know that you've selected a conductor that can take this kind of brutal punishment and still carry on!

Upon investigating a current outage in the vicinity of a coal stripping operation in Pennsylvania it was found that a bulldozer had shoved dirt and rocks over the edge of the workings until the two wires on a span of Copperweld-copper conductors had been completely covered and wrapped together.

To put the line back into service, the bulldozer was called upon to cut a valley, as shown in the photograph, allowing the wires to spring back into place. The line was re-energized without requiring repairs of any kind.

Copperweld-copper conductors stand up under gruelling service year after year—that's why you should always specify them on your rural lines.

COPPERWELD STEEL COMPANY • *Glassport, Pa.*
SALES OFFICES IN PRINCIPAL CITIES

Copperweld-copper Conductors

THE DEPENDABLE CONDUCTORS SERVING RURAL AMERICA

LOAD BUILDING

Commercial · Industrial · Residential · Rural

Examples for Peace Time in War-time Traffic Safety Lighting

F. G. DAVIDSON
Municipal Sales, Duquesne Light Co., Pittsburgh, Pa.

What can be contributed by adequate lighting to post-war improvements of streets and highways in terms of safety and of facilitation of traffic movement, is well demonstrated by some installations of traffic safety lighting designed to meet the conditions of the war period. A good example of such an installation is that on Grand Ave., the main traffic artery on Neville Island, near Pittsburgh, where some 30 large industrial plants are located.

When these plants turned to war production, the old 20-ft. roadway of Grand Ave. became woefully insufficient. It was replaced with one of four lanes, 80 ft. wide. This improvement solved the daytime problem, but the old street lighting system was inadequate for night traffic which had greatly increased because of the expansion in employment and the fact that most of the plants went from single shift to 24-hr. operation. Working hand in hand with officials of Neville Island, the street lighting engineers of the Duquesne Light Co. designed the lighting shown in the "after" photograph. Sixty-eight 600-candlepower lamps in modern directive type fixtures replaced twenty-six 250-candlepower lamps in radial wave units. The system was designed in accordance with Illuminating Engineering Society recommended practice of street lighting.

Good street lighting was important to Neville Island in wartime. It is equally important now because of the flood of traffic resulting from the elimination of gasoline rationing and the raising of speed limits. Not only will this engineered street lighting installation make Grand Ave. safer for vehicular and pedestrian traffic at night, but it will also discourage robbery, assault and juvenile delinquency.

•

Dressed-Up Prints Help Sell Lighting

Cold facts on blueprints, taken as a matter of course by engineers, are not so warmly acceptable to laymen, many of whom regard blueprints as devices for presenting information in terms incomprehensible to them. If the presentation were just on white, instead of on blue, some of the curse would be removed. Then if a little color were used to point up certain elements, the presentation might become really appealing to the eye and, through it, to the understanding. In short, technical information can be attractively packaged, and it ought to be, when it is an element in selling.

Appreciating this simple requirement in sales technique, the Birmingham (Ala.) Electric Co., as reported by T. D. Wakefield of the F. W. Wakefield Brass Co., furnishes white prints of recommended lighting installations to its customers. Prints are dressed up with brown crayon to block in walls, columns and partitions. Lighting units are indicated by blue, purple or other contrasting colors, different colors to show different types and sizes.

Result is that each prospective buyer of new lighting gets an attractive, understandable picture of the engineering features of his particular installation. Such presentations of lighting recommendations are especially appealing to customers in stores, offices and schools unfamiliar with engineering ways.

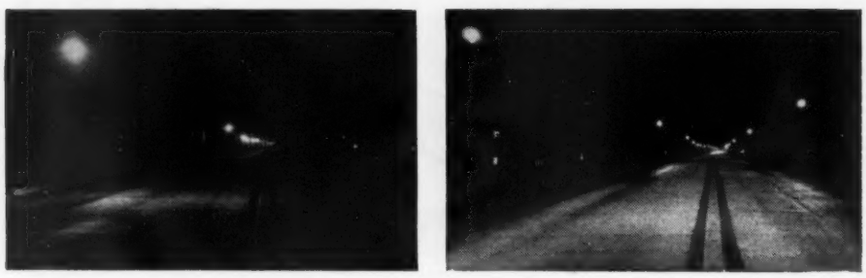
•

Dealer Paper to Aid in $34,740,000 Sales Promotion

H. C. RICE,
Merchandise Manager
Southern California Edison Co., Los Angeles

In its future domestic loadbuilding promotion, Southern California Edison Co. will eliminate all forms of direct sales and devote its entire activity to loadbuilding through dealers. As part of its promotional effort to aid dealers, the company will issue quarterly a four-page dealer paper to be called *Dealer News*. Circulation will include 1,500 to 1,800 appliance dealers as well as wholesalers, manufacturers, and manufacturers' agents and representatives.

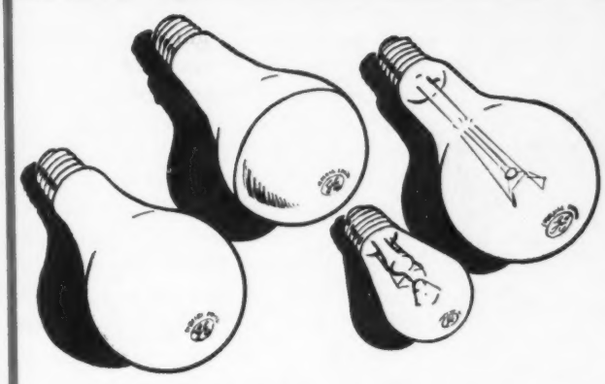
During each quarter of the year, one major appliance will be campaigned and in addition there will be several minor objectives. For instance, during the first quarter of this year electric water heaters will be the primary objective, with electric roasters, electric blankets, portable air heaters and the all-electric kitchen as secondary objectives. Front cover of *Dealer News* will carry general news-promotional material while the two center pages and back cover will be used to announce



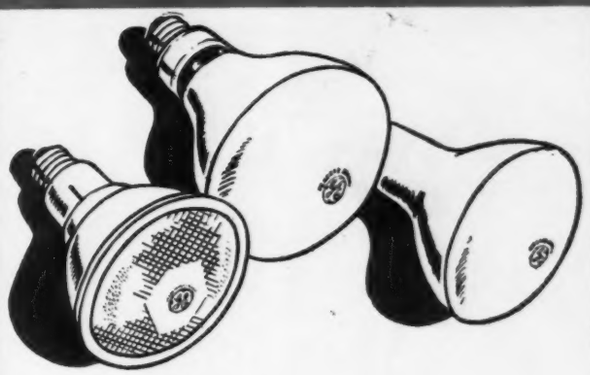
INADEQUATE INSTALLATION of 26 lamps of 250 cp. each in radial wave reflectors replaced by 68 modern, directive-type units with 600 cp. (right)

Lamps you need to Relight America—

MAKES 'EM ALL!



G-E Filament Lamps for general lighting jobs are made in sizes from 6 to 1500 watts; candelabra, intermediate, medium or mogul screw bases, or bi-post base in certain sizes. Standard lamps operate on 115, 120 and 125 volt circuits. Others made for 230 and 250 volt circuits and for low voltage farm service.



Concentrated beams and wide-spread floodlighting beams are available in G-E *REFLECTOR* and *PROJECTOR* lamps. Reflector Spot Lamps serve to high-light store displays; Reflector Flood for a spread beam in interiors. Projector Spot and Flood Lamps serve similarly in outdoor uses.

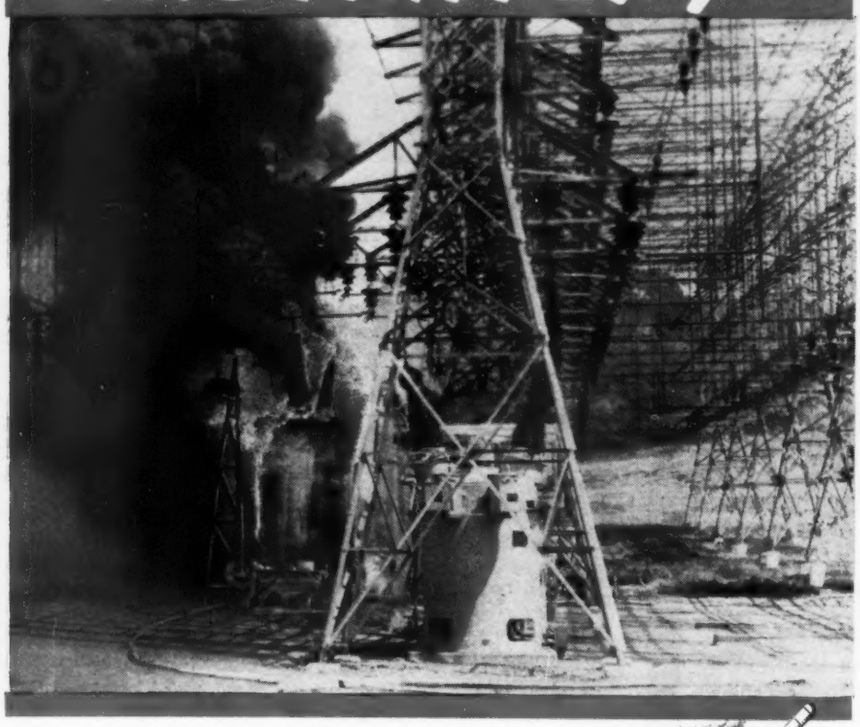
No lighting job can be better than its lamps. For over 60 years, General Electric research has led the way with an ever-increasing line of high-quality lamps for all kinds and types of lighting. This constant development will continue. G-E Lamp Research will provide even more and better light sources than ever before to help you get the full benefits from relighting America . . with lamps made to *Stay Brighter Longer.*

G-E LAMPS

Stay Brighter Longer!

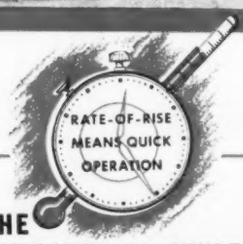
GENERAL ELECTRIC

"AUTOMATIC"
FIRE-FOG WOULD HAVE extinguished THIS BLAZE
• IT BLANKETS
• IT ISOLATES
• IT QUENCHES
INSTANTLY!



But these transformers were unprotected and an estimated $50,000.00 loss to equipment resulted. A needless loss too . . . . for with "Automatic" FIRE-FOG protection a different story would be told. At the very first indication of flame, FIRE-FOG'S action is *swift, automatic.* Its relentless, fire-fighting spray beats down the flames, cools the fire area, smothers the blaze . . . . and with surprisingly little water.

FIRE-FOG'S fire quenching ability has been proved many times and under most trying conditions. What it can do for you is best told by one of our engineers. Write today for detailed information.



THE SUPROTEX* SPRINKLER SYSTEM
—a famous member of the "Automatic Sprinkler Family. Designed particularly for use in manufacturing, mercantiles, warehouses, schools, churches, offices, hospitals, piers and other establishments where positive fire protection is essential.
* Trademark Registered U. S. Patent Office

"Automatic" Sprinkler
"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA
YOUNGSTOWN, OHIO . . . . . OFFICES IN 36 CITIES
"Automatic" Sprinkler designs, manufactures and installs a complete line of fire protection devices and systems for all types of fire hazards. Listed by Underwriters' Laboratories, Inc., and approved by Factory Mutual Laboratories

these quarterly objectives and outline campaign plans.

Issuance of this dealer paper will be only one step in the Edison Company's plan to aid dealers in selling $34,740,000 worth of loadbuilding appliances during 1946, if valued at 1942 prices. Connected load will be 208,000 kw., and estimated annual revenue $1,713,750.

•

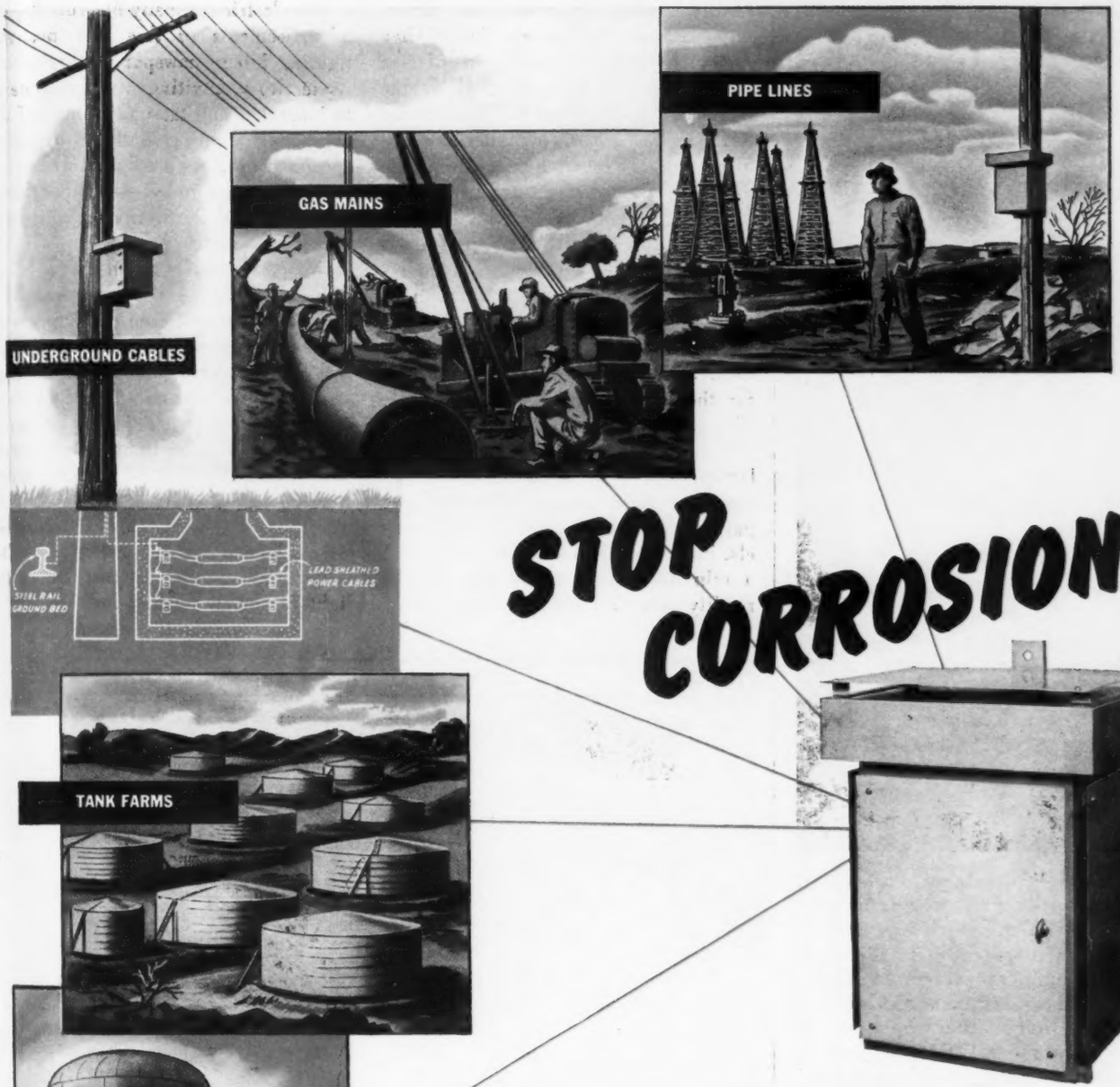
Small Store Lighting Sells More of Same

ANNA BELLE GOLDSWORTHY
Central Hudson Gas & Electric Corp.
Poughkeepsie, N. Y.

A good store lighting job has been the post-war plan of many merchants as they carried on business under wartime restrictions and shortages. Now that the post-war world is here, what is immediately available for them in a lighting installation of high quality? Aside from the degree of good illumination itself, the requirements of small stores are just as important to their communities and to the electric companies serving these communities as their larger business neighbors.

In the Hudson Valley territory served by the Central Hudson Gas & Electric Corp., installations of a post-war fixture especially adapted to small store needs are being made. The first of these installations was made last August in a small ice cream and candy store in Poughkeepsie. It's a simple, versatile fluorescent layout giving excellent illumination and providing fifty footcandles on counters and displays when completely turned on. What is just as important in a small store without janitor service, it is an easy matter to maintain the high quality of light and keep the fixtures shining clean. The owners, Mr. and Mrs. William Brendler, are enthusiastic over the illumination and the business-building results that came from the layout prepared by Taylor Barr, Central Hudson's Poughkeepsie district lighting engineer.

The post-war fixtures used to modernize the store, with a new paint job collaborating, are installed in continuous rows of light practically outlining the rectangular ceiling. Running along each side are seven of these fixtures, each having two parallel 48-inch, 40-watt fluorescent white tubes, while two run lengthwise above the soda fountain at the back, and one four-tube



STOP CORROSION!

...with Federal's Cathodic Protection

CORROSION TAKES a huge bite from industry's profits. Sub-surface cables, pipe lines and tanks . . . even water tanks above ground . . . are constantly attacked by electrolytic and galvanic action.

Federal Cathodic Protection is a dependable safeguard against this form of corrosion. By maintaining a constant direct current from earth to equipment (in above-surface structures, from water to tank's inner surface), Federal Selenium Rectifiers counteract destructive currents . . . and stop disintegration of metal surfaces.

These units operate from any standard AC supply. They do their work efficiently, silently . . . with no moving parts to wear, or require maintenance.

Learn how Federal selenium rectifying units can be put to work to guard your own installations. Write today for a copy of "Cathodic Protection and Applications of Selenium Rectifiers".

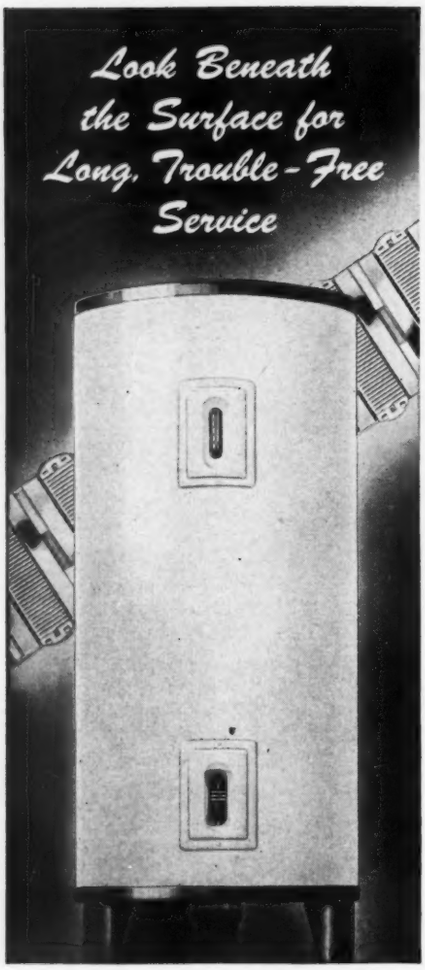
FEDERAL TELEPHONE & RADIO — FTR

Federal Telephone and Radio Corporation

An IT&T Associate

Newark 1, New Jersey

Export Distributor:
International Standard Electric Corporation



Just as you "cannot judge a book by its cover" neither can you predict the kind of service an electric water heater will give by its outer shell—it is what is underneath that counts. If you compare the inner construction of a Clark with that of other water heaters, you will find many little differences in material and design. But the big difference, the feature that guarantees long, faithful service is the famous Clark "Lifesaver" Element. If you are planning on merchandising electric water heaters you will find it well worth your while to get the facts about this time-tested feature found exclusively in the Clark. Our brochure "In a Nut Shell" is yours for the asking — may we send it to you?

A CLARK FRANCHISE FOR YOUR TERRITORY
MAY STILL BE OPEN WRITE FOR DETAILS

McGRAW ELECTRIC COMPANY
CLARK WATER HEATER DIVISION
5201 W. 65th ST., CHICAGO 38, ILL.

CLARK
ELECTRIC WATER HEATERS
A Toastmaster Product

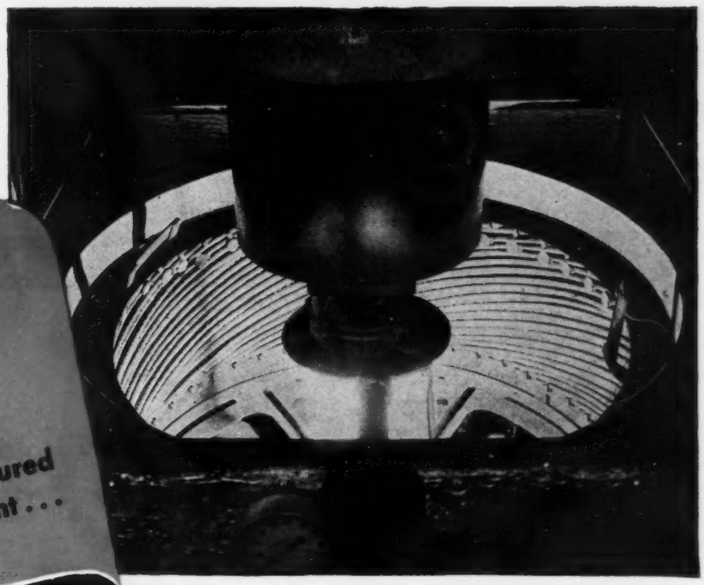
fixture is at the store entrance, allowing 3.5 watts per square foot. They are controlled by a group of six switches conveniently located at the front of the store near the main counter. On each side row alternate fixtures are operated by two separate switches while the fixture above the fountain and the one at the entrance are each operated by its individual switch. With this arrangement the merchant can obtain any combination of lighting he desires and can regulate the amount of energy usage in accordance with what he feels is practical for the various hours of store traffic. The fixture, fitted with ribbed glass side panels, is open at the bottom. The lamps can easily be cleaned or replaced from the floor without removing any part of the fixture, while the glass panels, having vertical surfaces, will catch a minimum of dust and can also be readily cleaned right in place.

The electric company has run display advertisements of this first post-war lighting job in newspapers throughout its territory, inviting other merchants to inspect it and take advantage of the company's lighting staff in preparing specifications. As a result storekeepers from quite a number of communities have inspected the store and some have decided on similar lighting. In other major communities of this area, Kingston, Newburgh, Beacon and Catskill, small stores soon began relighting with the same fixture and general layout, including a hardware store, a drug store, a ladies' dress shop and a haberdashery, using specifications prepared by Central Hudson lighting engineers. Advertisements of some of these other stores as they pioneer in good post-war illumination in their communities were planned by Central Hudson to keep kindling the interest in better light for better business.

Note to Storekeepers
First!
You are looking at before and after pictures of the first quality store lighting job installed in this area since hostilities ceased — a candy and ice cream store at 214 Hooker Ave., in Poughkeepsie!
This lighting installation is outstanding for a number of reasons:
(a) Fixtures are new design—long, continuous lines of light which seem to reach out and pull customers into the store.
(b) Fixtures are easy to maintain. To clean or change tubes it is not necessary to remove extensive glassware. The tubes, being open, just need an occasional dusting.
(c) Plenty of switches. Lights may be used in various combinations giving any level of light at any hour.
BEFORE
AFTER
SAYS BILL BRENDLER who, with Mrs. Brendler, are the Proprietors:
"Since installation of the new lights store traffic has increased tremendously. We're surprised, too, how merchandise on the shelves moves articles which always before were slow sellers."
STOREKEEPERS: You are invited to inspect this store. You are also invited to avail yourself of the free planning service which this company offers. Our lighting engineers will gladly make a lighting plan of your store. This costs you nothing and places you under no obligation.
CENTRAL HUDSON
GAS & ELECTRIC CORPORATION
"Serving the Central Hudson Valley"
Hear NELSON EDDY
"The ELECTRIC HOUR"
every Sunday afternoon at 4:30 . . . WABC

FIRST POST-WAR lighting job in small store is featured in utility advertisement

In the Weather-Ometer, Weatherproof coverings are subjected to the accelerated aging effects of sunlight, wetting and drying, freezing and thawing, simulating rain, sleet and searing sun.



THE PAST...

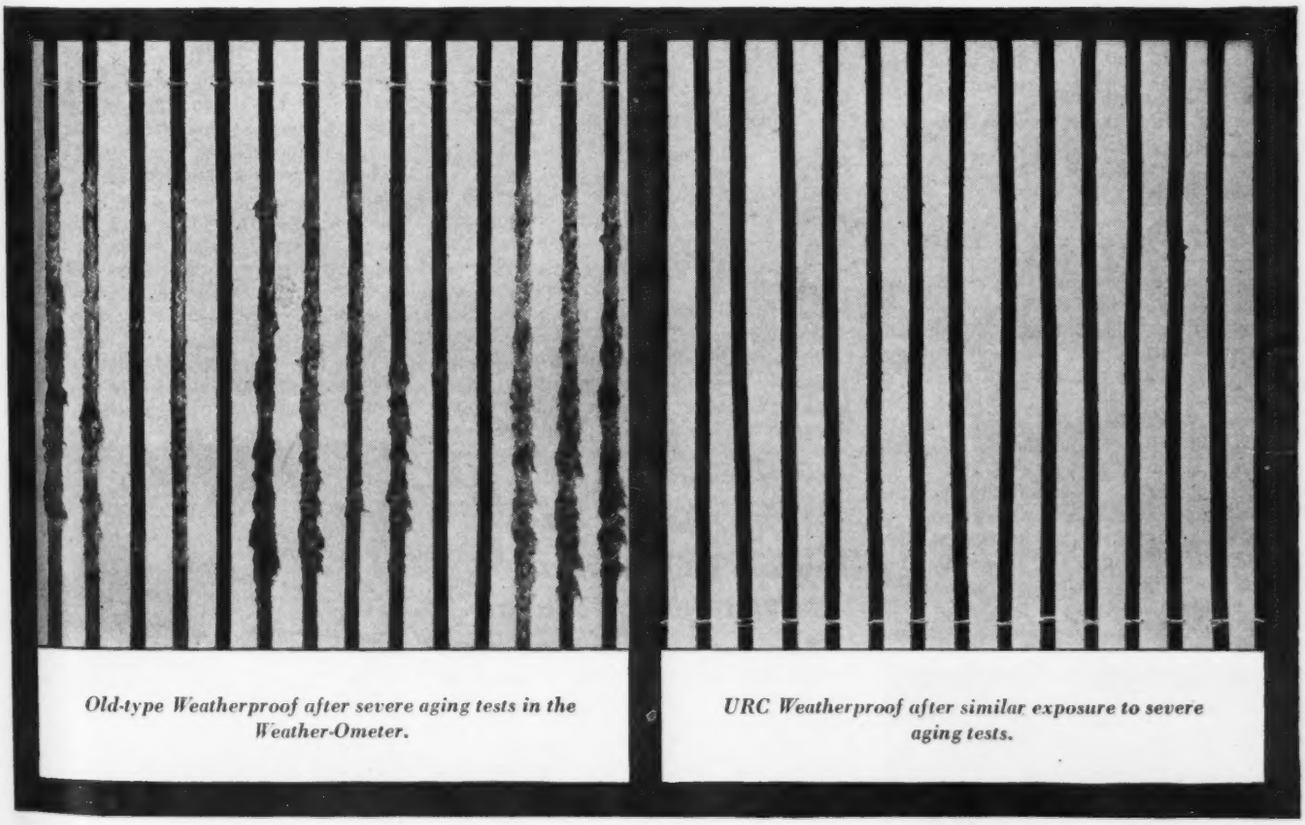
"Festooning" was not unusual...

THE PRESENT...

Today, lasting Weatherproof is assured by URC research and development...

For Continuity of Service... Anaconda Triple Braid or Duraline URC

• The long field service expectancy of URC Weatherproof is proven by exhaustive tests on materials and finished wire and cable. These data, plus actual field experience, indicate URC Weatherproof will last for years and years.



Old-type Weatherproof after severe aging tests in the Weather-Ometer.

URC Weatherproof after similar exposure to severe aging tests.

LOOK TO *Anaconda* FOR WEATHERPROOF THAT LASTS!

ANACONDA

NEW EQUIPMENT

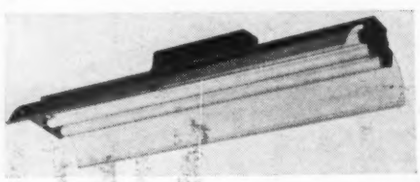
3 Fluorescent Fixtures Announced by Holdenline

Three new fluorescent fixtures are being announced by the Holdenline Co., Cleveland, Ohio. The P-24 (20H), a 24-in. single lamp fixture; CSS-80, a two-lamp 40-watt unit; and CSS-120, a three-lamp 40-watt fixture are all being brought out as the company enters its tenth year in the fluorescent fixture business.

The P-24 single lamp fixture was designed for localized lighting. It has exposed ballasts for cooler operation. The reflectors and the positive socket spacing are reported as so designed that flexible lighting is assured. It is also available in 48-in. lengths, P-48 (20H), and is reported as adaptable for factory or home use.

CSS-80, two-lamp 40-watt unit, has a polymerized synthetic finish on the reflectors which is reported to provide longer life and easier cleaning. Ballasts are exposed. The butt-on sockets are protected by sheet steel which is stated to prevent sag or breakage. The 2½-in. lamp spacing in continuous lighting is stated to eliminate dark areas between lamps.

CSS-120, three-lamp 40-watt unit, is said to combine strength, desirability and flexibility in lighting. The unit is shown in the accompanying illustration. It is said to have open ballasts, ample wire freeway, and photometrically designed reflectors for reducing glare and shadows. Sockets are welded to the end plates to eliminate breakage, to prevent sagging and to assure positive spacing.



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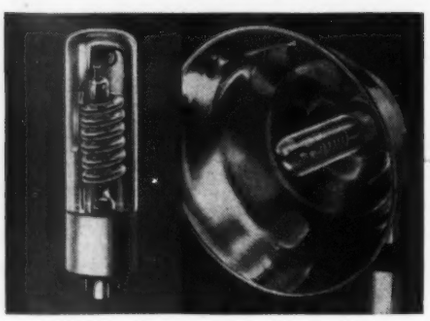
Flash Bulb Life Several Thousand Flashes

New repeating flash bulb that can be used for several thousand individual flashes of daylight quality photographic illumination was reported recently by Wabash Photolamp Corp., 335 Carroll St., Brooklyn 31, N. Y. The flash bulb is stated to provide a light output of 12,000,000 peak lumens in an instantaneous flash the equivalent of 1/5000th second.

Preliminary color tests indicate that the color quality of the light is already corrected to approximate that of normal daylight and that no filters will be required for indoor use with daylight type color films.

In appearance the bulb is similar to a projection lamp equipped with a porcelain three-pronged base. Inside the bulb is a Xenon gas-filled coiled glass tubing running between two electrodes. Condensers discharged through this coil provide the illumination.

This is the first of several bulbs of its type which Wabash will make available with their new Electroflash units soon to be announced. The first three types of complete units will include a light weight portable for press use, a small a.c. portable for general use, and a professional model for all studio and multiple flash work.



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Thinline Ballasts Have Constant Voltage Feature

Manufacture of two new "Thinline" fluorescent lamp ballasts specially designed for the operation of the new long, thin, hot cathode fluorescent lamps is being announced by Sola Electric Co., 2525 Clyburn Ave., Chicago, Ill. The first of a complete line to be offered for this purpose, these transformers are small light-weight units that incorporate the company's constant voltage principle. Wide line voltage variations are said not to affect this new transformer, and thereby to assure constant light output from the lamps, instant starting and long lamp life.

Reflector Floodlight Has Sealed Silver Lining

Designed primarily for floodlighting, supplementary commercial lighting, store interior and display lighting, a new "Reflector Floodlight" is being announced by Wabash Corp., Brooklyn 31, N. Y. It has a pure-silver reflector lining hermetically sealed inside. The light beam is moderately concentrated between a 0-60 deg. zone, and is stated to feather away to a soft diffusion at its edges.

The sealed-in silver lining is reported to keep the bulb at top reflecting efficiency throughout its life, with no loss of illumination due to tarnishing of the reflecting surface by atmospheric action.

The bulb is 5 in. in diameter at its widest point, is 6½ in. in over-all length, has a smooth outside surface to retard dust-collecting, and can be used in any standard socket, swivel type socket, or ceiling recessed fixture. Four sizes—100, 150, 200, and 300 watts—are available, each with an average reported burning life of 1,000 hr.

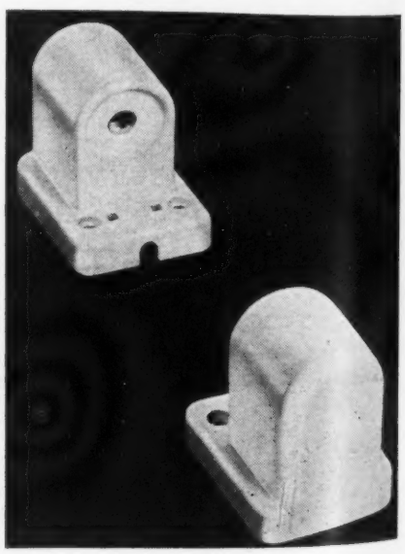
•

Slimline and Circline Holders Announced

Two new lampholders for slimline and circline fluorescent lamps have been announced by General Electric Co., 1285 Boston Ave., Bridgeport 2, Conn. The slimline lampholder (illustrated) is designed for use in general lighting fixtures. The circline lampholder has many applications for fixtures and portable lamps in commercial and industrial installations.

The slimline lampholders are of the medium, single-pin type for multiple service only. They accommodate the T8 and T6 lamps. Lampholders can be mounted to any flat surface and spaced on 2-in. centers minimum. Binding screws are located in the base. Two lampholders make up a pair for one lamp.

The circline lampholder accommodates 12-in. circline fluorescent lamps. This lampholder provides electrical connections, posi-



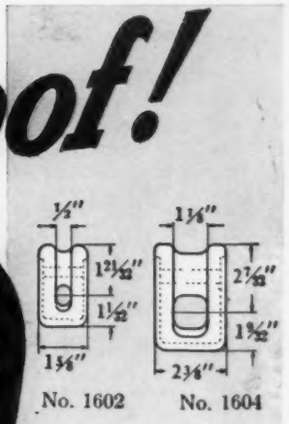
30 years of Proof!

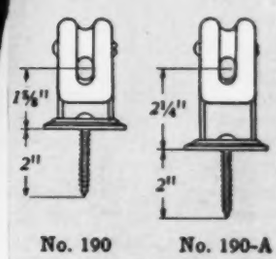
HUBBARD No. 190 WIREHOLDER

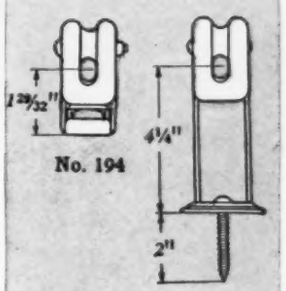
For more than 100 years, Hubbard and Company has enjoyed the privilege of serving industry with its greatly diversified products of the durable goods class.

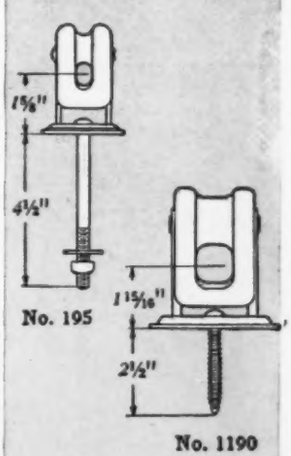
During the latter half of this century of service, the most notable group of materials has been a complete line of Pole Line Hardware, and for more than thirty years, Hubbard No. 190 Wireholders have been produced in quantities reaching well into the millions.

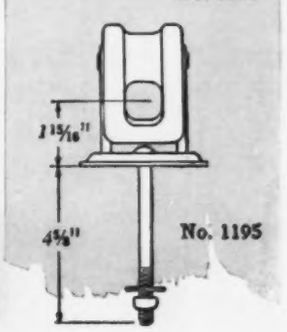
This old, reliable design with its variations shown here, is the favorite of many engineers and linemen from coast to coast. They know, that in thirty years of service, the Hubbard No. 190 has encountered every hazard to which a wireholder may be exposed. They know it has a slender pointed, full threaded screw for easy starting and maximum holding power in sheeting or solid wood. They know that its strength is much greater than that of the average service wire. They have discovered that this strength is due to the fact that the porcelain insulator is in compression with metal supports, not in tension, which is the weakest state of porcelain. They have thirty years proof that the Hubbard No. 190 has what they want in a wireholder.











Stock No.	DIMENSIONS—INCHES				Approximate Shipping Wt. Lbs., 100 Pcs.
	Insulator	Size of Screw, Bolt or Tap	Extension Base to Ctr. of Wire Hole	Size of Wire Hole	
190	1602	No. 22 x 2 Wood Screw	1-5/8	9/16 x 3/4	105
190-A	1602	No. 22 x 2 Wood Screw	2-1/4	9/16 x 3/4	115
190-R	1602	No. 22 x 2 Wood Screw	4-1/4	9/16 x 3/4	150
194	1602	5/8 Tap	1-29/32	9/16 x 3/4	95
195	1602	3/8 x 4-1/2 Carriage Bolt	1-5/8	9/16 x 3/4	140
1190	1604	No. 24 x 2-1/2 Wood Screw	1-15/16	1-1/8 x 1-1/8	228
1195	1604	3/8 x 4-5/8 Carriage Bolt	1-15/16	1-1/8 x 1-1/8	240

HUBBARD and COMPANY

PITTSBURGH • CHICAGO • OAKLAND, CALIFORNIA

tions the lamp and supports it at two points. One point has the electrical connections and the other provides the necessary tension to hold the lamp securely. A lamp is removed by grasping it at the plastic section and lifting pins out of contact.

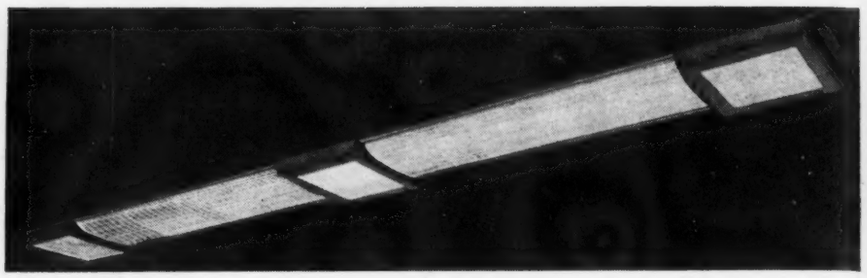
•

"Forty-Sixty" Luminaire Divides on 40-60 Basis

A new Alzak aluminum luminaire (No. 4060) for two 40-watt fluorescent lamps is being announced by Curtis Lighting Co., 6135 West 65th St., Chicago 38, Ill. It was designed for installation in offices, drafting rooms, school rooms, etc.

The unit is called the "Forty-Six" because, the report states, approximately 40 percent of the light is directed upward and 60 percent downward. Reflection and lower fins are aluminum, wiring channel and end plates are white Fluracite and end ornament is a plastic star finished in Ivorytone.

Dimensions of the fixture are 12½ in. wide, 5½ in. depth of body, and 48⅛ in. long. A special 12-in. two-stem hanger is provided with the unit and other lengths can be supplied when required.



Lighting Units Combine Fluorescent & Incandescent

Company's Holoflux units are now made in combination with incandescent Controlens units, according to word recently received from Holophane Co., Inc., 342 Madison Ave., New York, N. Y. Accent lighting is provided by inclusion of the No. 778 optical train.

When used with a 250-watt flood lamp an intense narrow beam results and, by an adjustable mechanical feature, the beam may be offset vertically as much as 35 deg. and rotated laterally through 360 deg. This combination was designed for general store lighting and to highlight featured merchandise.

Fluorescent units regularly interspersed with the incandescent units are said to meet the demands of certain departments where color value of the display is especially important.

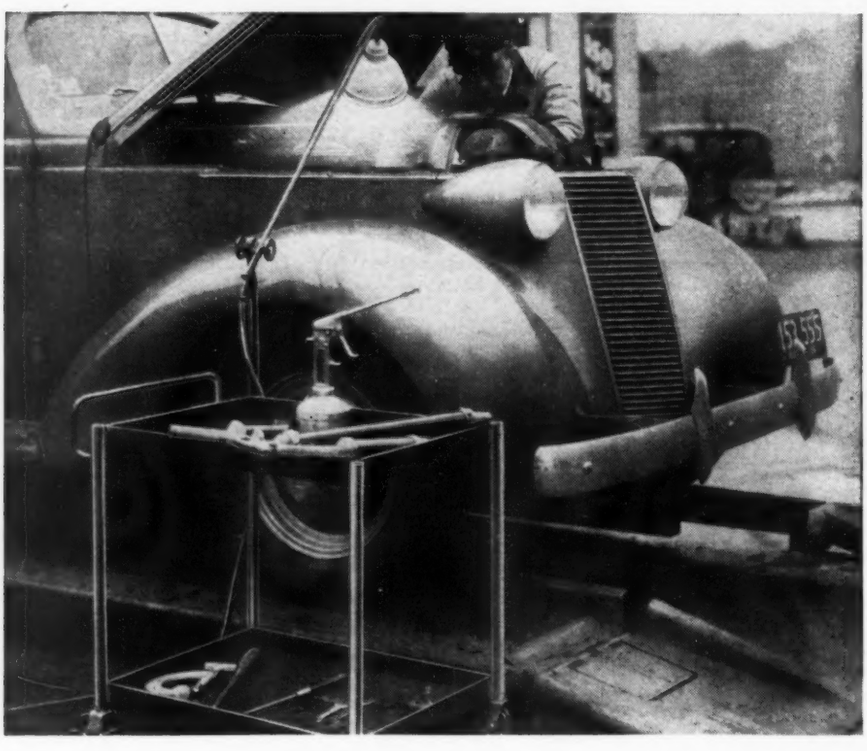
• • •

Light a-la-cart For Mechanics

Double utility tool cart equipped with a lighting unit, so that light can be brought to the job and, at the same time, provide a handy tray for tools and parts, is being announced by Revere Electric Mfg. Co., 6009 Broadway, Chicago 40, Ill.

The unit was designed as a convenience tool for mechanics. A 60-watt Alzak aluminum reflector is mounted on a wide-range adjustable arm which can be set on any one of the four supporting parts.

The cart is mounted on casters, one of which has a foot brake to prevent shifting or moving while in use.



•

Small Breaker Contacts Open 1 In. on Overload

All models of Aireon Mfg. Corp., Kansas City, Mo., new breakers are reported as suitable for a.c. or d.c. circuit use, to operate in any position and to be so constructed that they can be front or back connected. The line of breakers is of the 15-35 amp. capacity size and was developed for application in houses, railway cars, boats and factories.

The breakers are reported to contain a departure from past circuit breaker design. Instead of the usual parallel opposed contacts, it is said to embody a new design which carries the electrical contacts approximately 1 in. apart when overload occurs.

For home installation, the breakers are enclosed in a pressed steel cabinet and mounted behind the wall panel. The electrical circuits are controlled by one 3-position pointer knob for each circuit. These positions are marked "off", "on" and "reset."

The breakers are made for all classes of service and are available in sheet steel, raintight, water and dust tight, explosion resisting and submersion proof enclosures.

•

Announces 40-Watt Lamp For Refrigerator Use

A 40-watt lamp, specially designed for use in mechanical refrigerators, has been announced by the Lamp Department of General Electric Co. at Nela Park, Cleveland.

The new lamp, considerably smaller in size than the Company's 40-watt general service lamp, saves refrigerator space and reduces the cost of the lamp shield. It gives approximately the same light as the general service 40-watt lamp.

It is inside frosted, has a medium screw base, is designed for 120 volts, and has a rated life of 1,000 hours under specified test conditions.

•

Electronic Switch for Hazardous Areas

An electronic switch (Model No. 8336) for use in explosive gas areas is announced by United Cinephone Corp., Torrington, Conn.

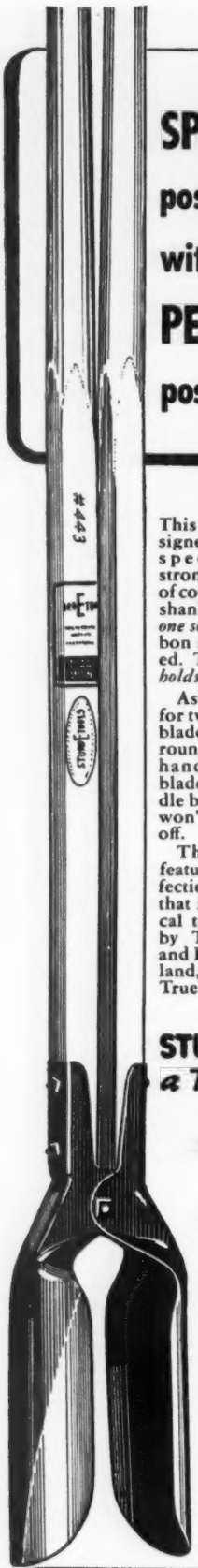
made to Sell.. with CHROMEL

Forty years ago electrical heating appliances were largely nuisance novelties . . . expensive, impractical, quick to burn out. Then came the discovery of CHROMEL, an inexpensive Nickel-Chromium alloy which combined high resistance to electricity with an amazing resistance to oxidation.

Today, millions of electrical heaters, toasters, ranges, irons, hair-dryers, and many other useful appliances with CHROMEL elements are entering their "umpteenth" year of trouble-free service for satisfied users, your customers. Technical data in Catalog M.

HOSKINS MANUFACTURING CO., DETROIT

Chromel
NICKEL CHROMIUM
HOSKINS
CHROMEL
ELECTRICAL HEATING ELEMENT
WIRE



SPEED post digging with this PERFECTION post hole digger

This SturdE digger is designed and engineered for speed—built by the strongest known method of construction. Blade and shank are forged from *one solid piece* of high carbon steel, then heat treated. The blade takes and *holds* a keen cutting edge.

Ash handles are square for two to three feet above blade. Then, tapered and rounded to give a firm, hand-fitting grip. The blade is attached to handle by hardened bolts that won't crystallize and shear off.

These special SturdE features give you a Perfection Post Hole Digger that is easy and economical to use. Manufactured by The American Fork and Hoe Company, Cleveland, Ohio, Makers of True Temper Products.

STURDETOOLS
A TRUE TEMPER PRODUCT

Tapered blade is 12 in. deep by 7 in. wide, forged from one solid piece of high carbon steel. Made in regular and heavy duty lengths. No seams, no joints, no welds to weaken and fail. Ash handles (7 and 8 ft.) sanded and lacquered, have a 34 in. span when open, carry foot marks to show depth of hole.

Distributed by
JOSLYN MFG. & SUPPLY COMPANY
20 North Wacker Drive • Chicago, Illinois
Branches and Warehouses with Complete Stocks in Principal Cities of the United States

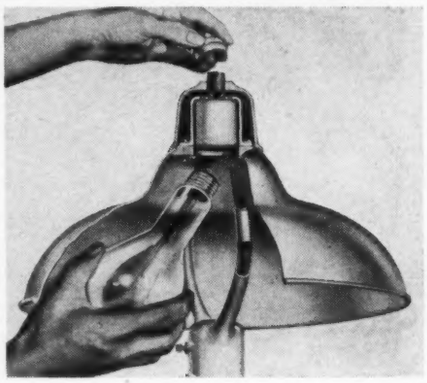
The contacts, which are hermetically sealed, are rated at 30 amp.

The switch was developed primarily for pressureless limit switching, floatless control of liquid levels and to eliminate contact arcs and welds. The report states that maintenance, beyond replacing the type 2050 Thyraton tube, is not required.

•

Flood and Spotlight Developed for Island Use

A low mounting floodlight, which permits conversion into a double-purpose area lighter and spot lighter all in one unit, is among the late developments of the Revere Electric Mfg. Co., 6009 Broadway, Chicago 60, Ill. The unit was designed for flood-



lighting service stations pump islands and spotlighting buildings, billboards, signs, etc., all from a single point.

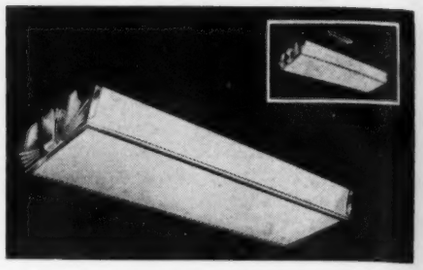
If a top floodlight is not desired, an illuminated advertising device, identification sign or other insignia can be mounted to further its usefulness.

The reflector is 20 in. in diameter, available in steel, porcelain enameled, or Alzak aluminum. One feature with the porcelain enameled reflectors is that they are available in a variety of colors which permit maintaining the color scheme of any particular station. The socket housing is a combination casting, comprising the mounting base and the supporting arms. The arms have a wireway to serve the floodlight or the units mounted on top. An ornamental ball is used on extreme top if top floodlights are not used. Top floodlights of 150-200 or 300-500 watt capacity can be mounted single or tandem.

•

Luminaires Feature One-Man Quick-Mount

New two-light and four-light commercial fluorescent luminaires in regular and Instant-Start models for stores, offices, schools, and public buildings have been designed by the Mitchell Manufacturing Co., 2525 Clyborn St., Chicago 14, Ill. These units are said to combine high light output with minimum glare. Light is diffused with two double-strength ceramic treated side panels and one double-strength prismatic ribbed glass bottom panel. Panels are reported easy to remove and clean. "One-man Quick-mount" feature enables one man to wire and hang



these units easily and quickly, it is stated. All-steel wireway channel and reflector are finished in durable white baked enamel. End plates are of Satin Aluminum, with translucent luminous effect. Units may be surface or suspension mounted, singly or in continuous rows.

These luminaires are Fluer-O-Lier, E.T.L., and U. L. approved. Each unit is completely wired, ready for hanging and has standard Tulamp Ballast, sockets, and starters. Power factor is reported as over 90 percent.

•

First Thermosetting, Shock Resistant Plastic in Color

Washing machine agitators, appliance housings, refrigerator trays and other common appliance parts and auxiliaries may now be produced in a range of standard colors by the use of a new plastic, Melmac 3020, American Cyanamid Co., 30 Rockefeller Plaza, New York, N. Y., states.

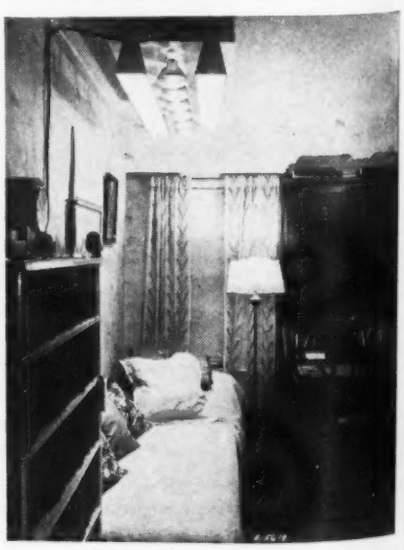
This compound is a rag-filled melamine-formaldehyde molding material and is reported as the first thermosetting, shock resisting plastic available in color.

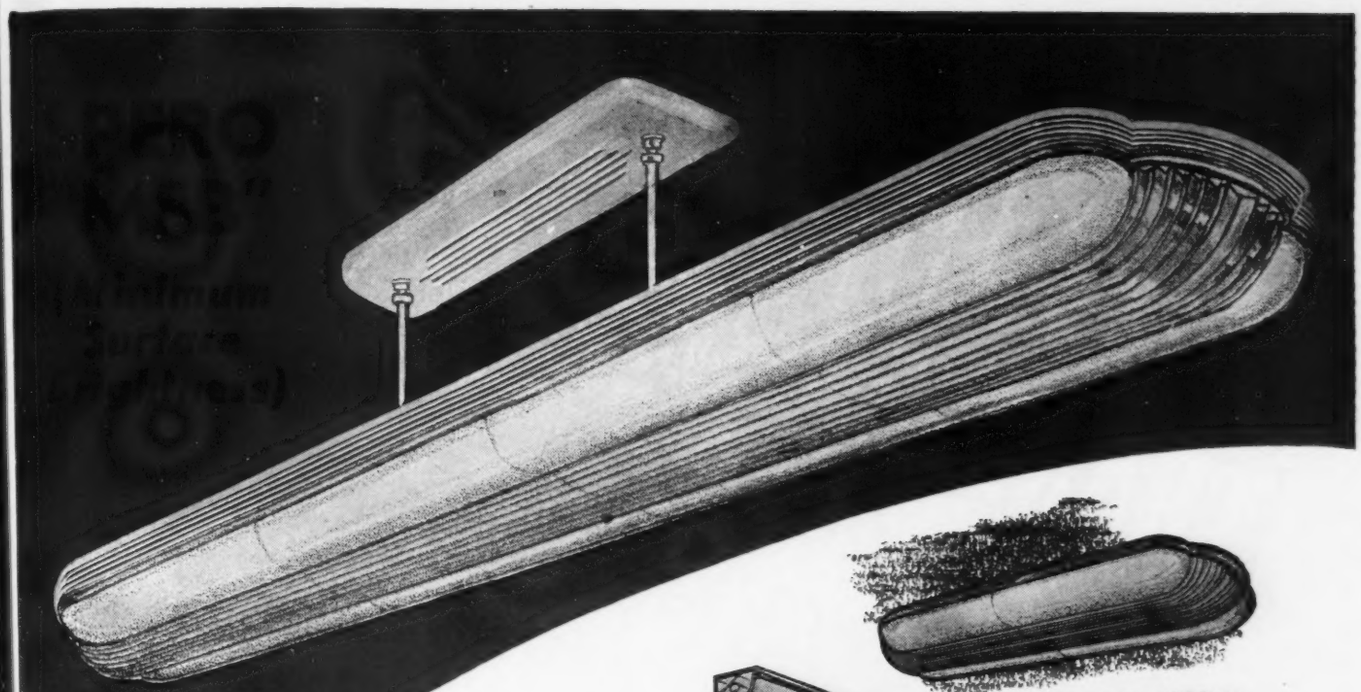
Originally designed to combine strength with the inherent electrical and chemical properties of basic plastic, it has previously been supplied in black and white only.

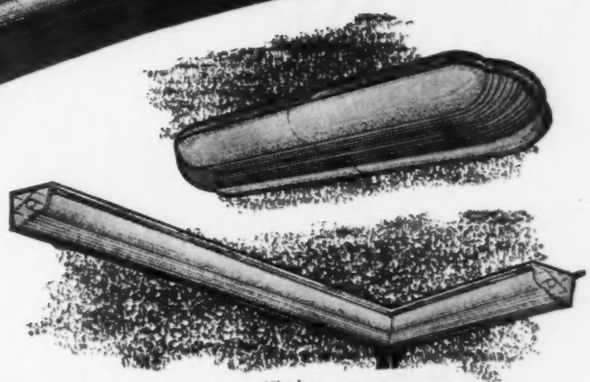
•

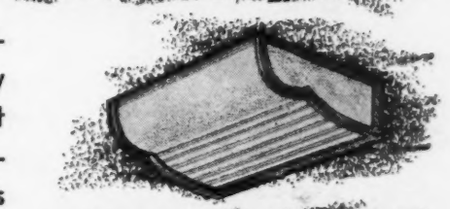
"Summer Sun Indoors" Via Overhead Fixture

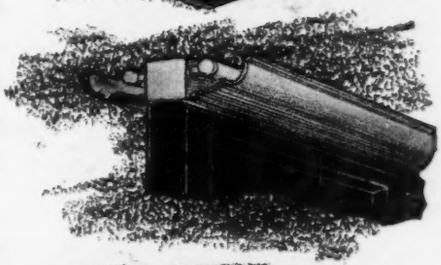
Bringing the "summer sun indoors" was the thought behind the development of the experimental ultraviolet-infrared sunlamp fixture illustrated. It employs two 40-watt







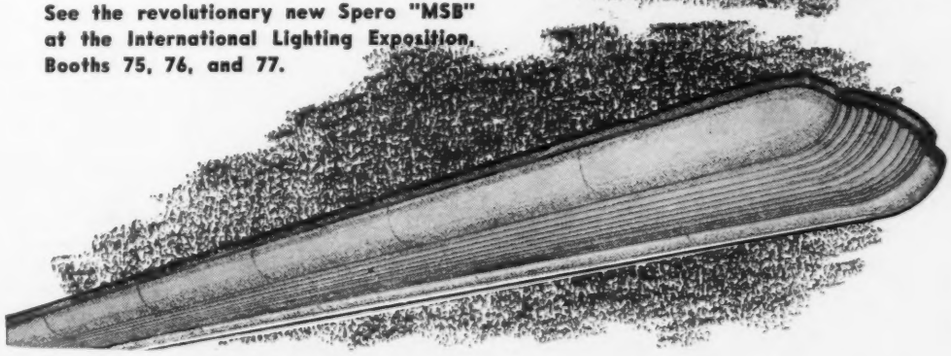




NEW GLASS-SHIELDED FLUORESCENT

Modern illuminating engineering has been applied to architectural glassware, bringing fluorescent lighting into harmony with the most smartly appointed interior decorations. Light is shielded by ceramic-finish glass, achieving high transmission with low surface brightness. Scientific design controls light in desired areas. Glass is molded in 12" sections—individual sections easily removable. Adaptable to stem or flush mounting, singly or continuous. A few of the many other applications of Spero "MSB" are illustrated at right.

See the revolutionary new Spero "MSB" at the International Lighting Exposition, Booths 75, 76, and 77.



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TRANSFORMERS
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Uptegraff Power Transformer, 1500 KVA type O.I.S.C., oil immersed, self-cooled; 3-phase, 60 cycles, 33000 volts star connected to 480 volts delta.
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The long record of outstanding performance of Uptegraff Power Transformers is evidence of the satisfaction they will give you.
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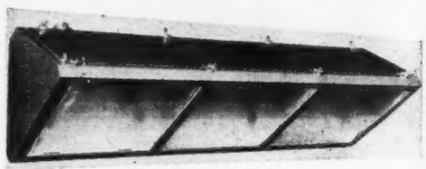
Write for Bulletin No. 114, and tell us your requirements. Install Uptegraff Transformers and be assured of Quality and Service.

fluorescent sunlamp tubes, suitable reflectors therefor, and six self-eflecting R-40 heat lamps, each rated at 250 watts. The new F-type sunlamp tubes will be available as soon as manufacturing facilities permit, reports the General Electric Co.,, Nela Park, Cleveland, Ohio, designers and developers of the experimental installation.

•

Industrial Fluorescent Unit Is Dust-Tight

A newly designed unit with smooth-outside Controlenses, of shock-resisting Hi-Stress crystal glass, clamped and cemented



in the bottom to make a rigid and permanent dust-tight seal, is being announced by Holophane Co., 342 Madison Ave., New York 17, N. Y. The report states this seal need never be disturbed, as easy access to lamps and ballast may be had through a solid steel hinged door in the side of the unit, secured by quick-acting cam-type bolts.

For servicing, the plate holding the sockets, starters, lamps and ballast can be rotated—by opening a spring snap latch—so that either the lamps and starters or the ballast is toward the door. The entire socket, starter, ballast and wiring assembly with their holding plate can be removed through the door by disconnecting the wiring from the terminal block.

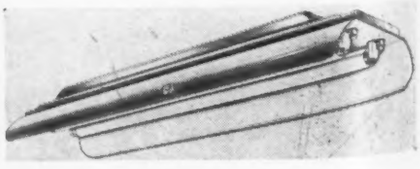
This unit is listed under the Underwriter's Laboratories reexamination service for Class Two, Groups E, F and G, which apply to atmospheres containing metal dust, carbon black, coal or coke dust as well as flour, starch and grain dust. Applications for this unit also include locations where non-explosive dust is prevalent which would seriously interfere with the efficient functioning of a fixture that was not dust-tight.

•

Industrial Fixture Has One-Piece Top

Tur-A-Top, an industrial fixture designed for single unit installation only, is being announced by DayBrite Lighting Co., 5411 Bulwer Ave., St. Louis 7, Mo. It is available for two and three 40-watt fluorescent lamps and two 100-watt fluorescent lamps. The top housing is die drawn from one piece of steel, which is said to simplify assembly and maintenance operations, and to reduce any danger of misalignment and loose parts.

The reflector, which is said to be easily removable, is finished in vitreous porcelain enamel.



CATALOGS and BULLETINS

A monthly digest of recent manufacturers' literature compiled by Electrical World for your convenience. Secure, without obligation, the most recent information on electrical and allied products

CHECK BULLETINS DESIRED ON COUPON AND MAIL TO US. WE WILL FORWARD REQUESTS TO MANUFACTURERS

1 TRANSFORMER: A 22-page booklet devoted entirely to power transformers. The booklet is 15½ x 11 in. in size and is divided into three sections. The first contains subsections describing economy, design advances since 1930, and an interesting projection into the future on what "tomorrow's" transformer design will include. The second section is a pictorial depiction of how the transformers are made and the third, a pictorial display of many of the company's outstanding power transformer installations in the utility field. Allis-Chalmers Mfg. Co.

2 HEAVY DUTY RELAYS: Bulletin 130 features a line of heavy duty relays, including single-, double-, three- and four-pole types. Also included is information on terminals and enclosures, on mechanical latching relays with and without interlock contacts. Illustrations and coil and contact data diagrams of each type of relay are shown. Ward Leonard Electric Co.

3 TUNGSTEN, MOLYBDENUM & SPECIAL ALLOYS: Catalog 156 contains 60 pages of information on the multitudinous applications of tungsten and molybdenum products. In addition to products listed, there are included an outline of the manufacturing processes behind each product, major applications, data on chemical and physical properties and numerous tables and graphs. Callite Tungsten Corp.

4 VINYLITE PLASTICS: Illustrated 19-page booklet discusses molding and extrusion compounds, flexible sheeting and film, cloth coating compounds, and describes the properties of each. Discussed also are actual and potential vinylite elastomeric extrusion compounds which include battery tubing, welding equipment tubing, and refrigerator drain tubes. In the electrical field other compounds are widely used on numerous types of wire and cable such as communication cable, substation wire, control wire and cable, motor lead wire, etc. Bakelite Corp.

5 WELDING ELECTRODES: Catalog 1B contains full details and helpful data on welding electrodes, plates, rods, paste, resistance welding tips and similar other products for industrial use. Stackpole Carbon Co.

6 ARC WELDING ACCESSORIES: Folder DM-709 announces a complete new line of arc welding accessories for the welding trade. Includes camlock cable connectors, grip-tite dual tools, carbon arc electrode holders, lugs and terminals, etc. All items are described and illustrated and are properly identified with catalog numbers. The Hobart Bros. Co.

7 HIGH VACUUM SYSTEMS: A 24-page booklet entitled "High Vacuum for Industry" discusses pressures in the range of 0.000001 to 1 mm. Hg., used for miscellaneous commercial applications. Principal uses of these pressures today are in the production of penicillin, blood plasma, optics, food, magnesium and many other things. Some of the equipment employed in such a system are: fore-pumps, diffusion pumps, condensers, vacuum valves, vacuum plumbing, vacuum gages and controls. Schematic diagrams showing fundamental elements to be found in any vacuum system are included, together with useful relations and tables in high vacuum techniques. National Research Corp.

8 CONVEYOR BELTS: Folder relates job this company's belts accomplished during the building of Shasta Dam. This belting carried 12 million tons of material during the dam's construction, operated 24 hours daily, 30 days monthly. Principles and construction of the cord conveyor belts are explained and outlined. The B. F. Goodrich Co.

9 VALVE SELECTION CHART: Designed for shop training or for a refresher on valves is this new Valve Selection Chart. It is available on heavy cardboard for handy reference. Easy to follow and understand, this chart explains the conditions to consider when selecting a valve, breaks down these conditions to determine how they affect the operation of the valve. American Chain & Cable Co., Inc.

10 STAINLESS STEEL STRAND: Folder describes and illustrates story of stainless steel strand, designed for ground wire, transmission lines, messenger wire, catenary construction on electrified railways, guy strand, etc. Physical characteristics are given together with tables con-

Circle numbers, sign and mail

April 13, 1946

ELECTRICAL WORLD
330 West 42nd St., New York 18, N. Y.

Please send me, without obligation, manufacturers' literature herein described and identified by numbers circled below:

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33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	

Print your name and address and be sure to include your title

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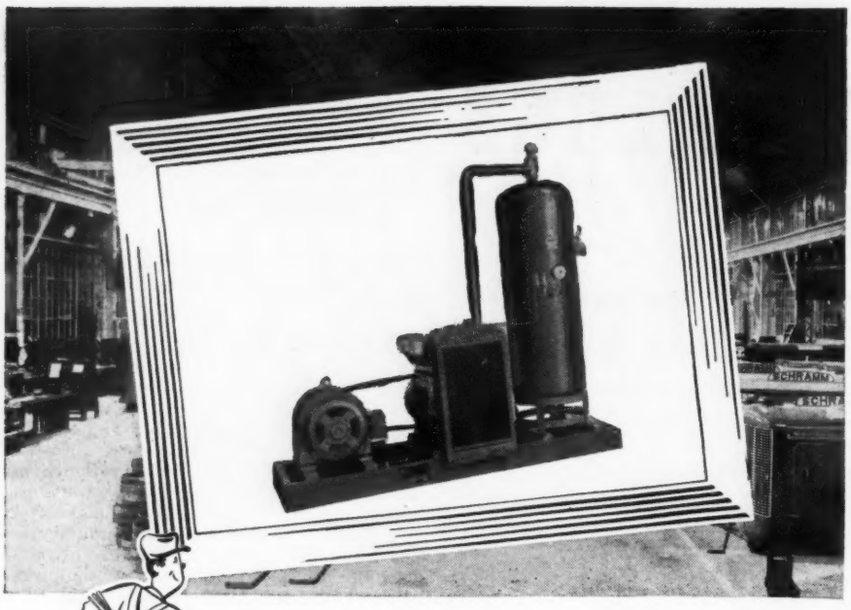


IN AIR COMPRESSORS . . . THERE ARE *Masterpieces, too*

Specialized workers make Schramm Air Compressors with that all-important "Know-How". So, when you get your Schramm Air Compressor you know you are not only getting a compressor with many exclusive features, but you know Schramm workers are assembling the features right, testing them thoroughly, and making a Masterpiece!

Schramm, with its enlarged facilities and modern plant at West Chester, produces on a large scale for industry. Schramm's expert workers and larger, modern facilities are geared to meet your needs for Air Compressors, both portable and stationary, in a wide range of sizes, for any requirements.

Today's features of Schramm Compressors are those that have stood up so well under the test of actual performance. These features include (1) 100% watercooled (2) mechanical intake valve (3) forced feed lubrication (4) main bearings between every cylinder (5) compact and lightweight.

Post-war industry will find many uses for the versatile Schramm Air Compressor. We invite you to write today for our new catalog and become acquainted with the construction features and details of the many Schramm models.

SCHRAMM INC.

THE COMPRESSOR PEOPLE
WEST CHESTER
PENNSYLVANIA

taining data on common wire gages, areas and weights. American Chain & Cable Co., Inc.

11 RADIO AND TELEPHONE CIRCUITS PLUGS: This 12-page catalog lists five plugs and three receptacle types which, with six insert arrangements, make possible 48 different fittings. Originally designed for the United States Army Signal Corps, this series has been used extensively in many types of radio, telephone and sound circuits where a rugged fitting, gasketed for weather resistance, is required. Contains an information section showing exploded views of three plugs and one receptacle. Also dimensional sketches, photos and application views. Dust caps are also illustrated. Cannon Electric Development Co.

12 FIBREGLAS ELECTRICAL INSULATION MATERIALS: A 12-page booklet features properties and test data of Fiberglas electrical insulation materials. These include yarns, cordage, tapes, sleevings, and cloths. The yarns are used largely for direct application as a serving on magnet wire or as a base for a braided covering in various other types of wire or cables. Illustrations and test curves are also included. Owens-Corning Fiberglas Corp.

13 PRESSURE OPERATED SWITCHES: An 18-page bulletin describes and illustrates three types of pressure operated switches, each adapted for a particular application. These switches can be made to start or stop automatically pumps, motors, warning devices, close or open valves, actuate counters and maintain desired pressures. Tables and diagrammatic drawings are furnished, showing in detail construction features of each switch. Meletron Corp.

14 MATERIAL-HANDLING HANDBOOK: Material-handling handbook, just republished with minor changes, bears on the economics and practical carrying through of an efficient moving and storage system for handling materials. It is illustrated with photographs and graphs and contains four sections of text dealing with the place of material handling in industrial management. Gives a complete description of truck handling systems and their comparative costs, direct and indirect, methods for organizing a material handling system, a discussion of battery capacities, coupled with an appendix dealing with floor loading, protection against fires and explosions and auxiliary equipment. Electric Industrial Truck Association.

15 BOILERS: Bulletin 445 features specially designed boilers for utility plants and other users. Sectional view of a 675-psi. boiler is shown, together with actual photograph of a relay-operated flowmatic regulator. Northern Equipment Co.

16 AUTOMATIC CLUTCH: Bulletin 4501 describes and illustrates an automatic clutch, designed for operating loads up to 6 hp. Clutch employs centrifugal automatic action. Illustrations and construction details are given. Table, containing dimensional data, is also shown. Salsbury Motors, Inc.

17 INSTRUMENT SPRINGS: A 12-page booklet discusses grades of spring needed for satisfactory performances of instruments. Contains apt photographs, drawings and curves showing amount of deflection. An historical background to the

NEOPRENE WINS
A TEN YEAR ENDURANCE TEST!

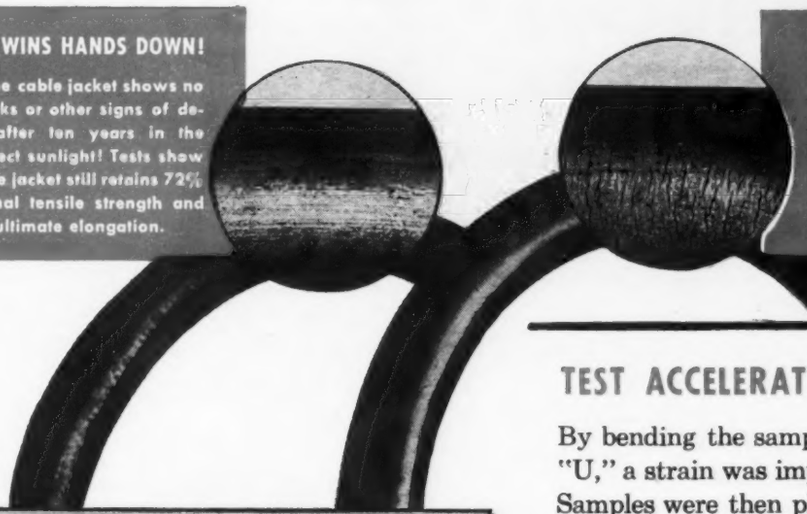
Cable jackets exposed to weather and sunlight in grueling test for durability

NEOPRENE WINS HANDS DOWN!

The neoprene cable jacket shows no surface cracks or other signs of deterioration after ten years in the open, in direct sunlight! Tests show the neoprene jacket still retains 72% of its original tensile strength and 85% of its ultimate elongation.

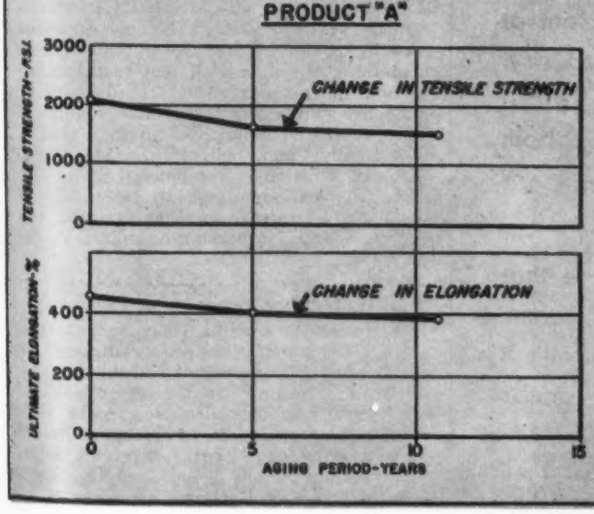
NATURAL RUBBER FAILS EARLY!

The photograph shows the natural rubber jacket cracked so extensively that it is unfit for service. After five years the cracks were so pronounced that it was impractical to test the rubber jacket for tensile strength and ultimate elongation.



AN INTERESTING NOTE

The graph shows that neoprene's rate of change in physical properties gets smaller as the years go by—with the greatest rate of change in the first five years.



TEST ACCELERATED BY STRAIN!

By bending the samples in the form of a "U," a strain was imposed on the jacket. Samples were then placed outdoors fully exposed to the weather and direct sunlight for 10 years and 7 months.

LOOK TO NEOPRENE for better wire and cable jackets—and *wherever* you need a durable elastic material that is really resilient and is highly resistant to heat and flame, to sunlight and weathering, to abrasion and wear, to oil and grease, to acids and chemicals, to aging and oxidation, and to the action of ozone.

WRITE FOR *a free subscription to* The Neoprene Notebook. *Interesting stories of new or unusual neoprene applications — which may suggest new ideas to you!*

RUBBER CHEMICALS DIVISION
E. I. du Pont de Nemours & Co. (Inc.)
Wilmington 98, Delaware

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

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FOR BETTER EQUIPMENT SPECIFY

DU PONT NEOPRENE

THE *VERSATILE* SYNTHETIC RUBBER

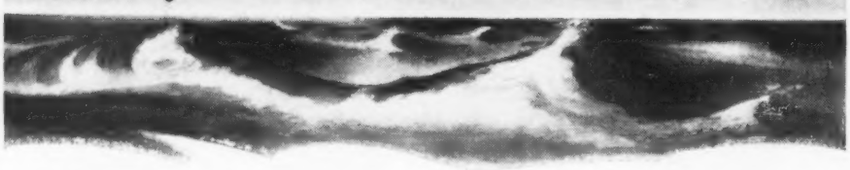
Sparkling Clean

AS THE SOURCE ITSELF!

Hot Water from SMITHway

PERMAGLAS

WATER HEATERS



There's Only ONE PERMAGLAS

CLEAN... sparkling... hot—just as pure as it is received from the source!

That's the hot water a SMITHway *Permaglas* Water Heater provides—hot water and *hot water convenience* to match the finest in today's best homes.

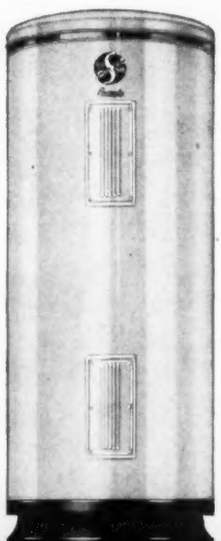
Sparkling blue, mirror-smooth *Permaglas* is glass-fused-to-steel—a triumph of home-appliance engineering proved in 23,000 test-years with waters from every state in the country.

SMITHway Permaglas GLASS-FUSED-TO-STEEL A GREAT AID TO SALES

SMITHway *Permaglas* Water Heaters provide you with the most dramatic, new sales story in the appliance business...

The monotriad, glass-lined heater tank, sanitary as a clean drinking glass; freedom from tank rusting and corroding—no tank-corrosion in the bath... no "tank spots" on clean laundry. Sparkling clean hot water as pure as the source itself!

Send today for the revealing booklet, "The Inside Story of Permaglas."



HOT WATER BY wire

A.O. SMITH Corporation

NEW YORK 17 • PITTSBURGH 22 • CHICAGO 4 • TULSA 3 • HOUSTON 2 • DALLAS 1
LOS ANGELES 54 • SEATTLE 4 • INTERNATIONAL DIVISION: MILWAUKEE 1
In Canada: JOHN INGLIS CO., LIMITED

SMITHway Permaglas GLASS-FUSED-TO-STEEL ELECTRIC WATER HEATERS

discovery and subsequent developments of spring-controlled instruments is given in the introduction. All-Weather Springs.

18 HAND TACHOMETER: One-page bulletin announces a special type multi-range hand tachometer. Principally used for measuring cutting speeds in ft. per min. on lathes and milling machines, obtaining linear speeds of planer beds and shapers and for measuring rotational speeds of motors, generators, turbines, and engines. Unit is complete in carrying case. Metrow Instrument Co.

19 LIGHTING: A 120-page brochure entitled "Ceilings Unlimited" is essentially a guide book to the modern, simplified system of commercial lighting. It tells the complete, interesting story of the specially designed traffic lighting system for offices, stores, schools, public buildings and factories. Examples of ceiling designs worked out with this system are shown, giving complete engineering and installation details. The Miller Co.

20 REEL ROLLERS: Folder illustrates and describes a reel roller, designed for use by contractors, wholesalers, storekeepers, utilities and manufacturers. Roller is built to roll reels of electrical wire and cables, steel strand, rope, etc. Illustrations and technical data are given. Roll-A-Reel.

21 TRANSFORMERS: Bulletin 39-10 features long list of dry-type transformers. Many uses are: means of providing a lighting circuit from a power circuit; operating low voltage portable tools, electric control devices, annunciation, etc., from power circuits; balancing voltage on a single-phase 3-wire system to prevent unsatisfactory undervoltage; obtaining a 3-wire circuit from a 2-wire system; and changing from 3-phase to 2-phase. Tables and technical data are supplied. Kuhlman Electric Co.

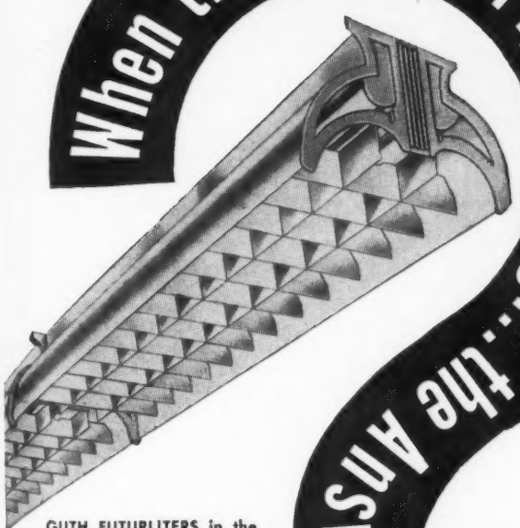
22 FIRE EXTINGUISHER INSTRUCTION CARDS: A new series of concise, comprehensive instruction cards, explaining the operation and maintenance of four of the most widely used types of hand fire extinguishers, are now available. They cover the Foam, Soda-Acid, Vaporizing Liquid, and Carbon Dioxide types. Clear illustrations accompany the text and show the various steps to be taken in handling, operating, and maintaining the extinguishers. American-LaFrance-Foamite Corp.

23 RAILWAY SIGNAL BATTERIES: Bulletin 900 is a manual covering the use of batteries, and is especially directed to the signal engineer, signal maintainer, and signal supervisor. Manual deals with a wide variety of batteries used in the railroad field. Includes complete technical data, together with cutaway views, large illustrations, tables and specifications. Gould Storage & Battery Corp.

24 LIGHTING AND ACCESSORIES: Catalog contains major lines carried by manufacturer. Includes a variety of industrial lighting units, commercial fluorescent luminaires, floodlighting equipment, sockets, brackets, fittings, switchplates, surface cabinets and pull boxes. Illustrations and tables giving pertinent information are also included. The Spero Electric Corp.

25 HIGH FREQUENCY CABLES: Data sheet 113 covers the high frequency coaxial cable field, specially designed for

When the Question Is Lighting... the Answer Is...



GUTH FUTURLITERS in the above photos demonstrate the "Keyed to the Specific Lighting Job" features of GUTH FLUORESCENT. FUTURLITERS are providing the *quality* and *quantity* of light required both in office and in store. GUTH Eggcrate Louvres have been added to the FUTURLITERS to provide additional lamp shielding for the more exacting "seeing" job in the office.

"Keyed" to the Specific Lighting Job!

The "Know-How" gained during 44 years in Lighting, is built into GUTH FLUORESCENT in *tangible* quality features, to meet the requirements of any specific lighting job, whether in office, store, factory, school or institution.

The GUTH FLUORESCENT line offers a practical selection of high-performance reflector finishes and reflector types for correct light distribution; proper lamp shielding, built-in, or with louvres or baffles; efficient diffusion, with glass or plastic diffusers. And GUTH FLUORESCENTS are modernly styled in a full range of the newest luminaire developments.

Thus, with GUTH FLUORESCENTS, you have a wide choice of the variables, that control the quantity and quality of light, to assist in the fine engineering required in today's lighting installations.

Data on above Photos: In OFFICE, GUTH FUTURLITERS provide 68 F. C. using 2.3 watts/sq. ft. Mounted in rows spread 8'0" apart on 11'0" ceiling.

In STORE, GUTH FUTURLITERS, deliver 64 to 75 F. C. using 3-40W fluorescent lamps per section. Mounted at 9'0" from 12'0" ceiling in rows 8'0" apart.

In FACTORY, GUTH MAZELITES, afford 30 to 32 F. C. of good working light. Mounted 9'6" high on 7'6" centers in rows 9'6" apart.

Guth FLUORESCENT

LEADERS IN LIGHTING SINCE 1902

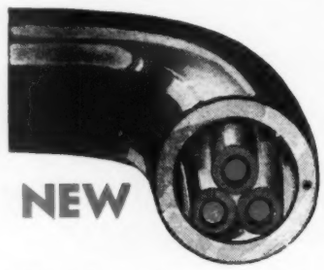
THE EDWIN F. GUTH COMPANY • 2615 Washington Ave. • St. Louis 3, Missouri

CRESCENT SYNTHOL TYPE T

OLD

3 No. 12 Type R Carry 20 Amps.

Allows Larger Capacity On New Installations and Permits **DOUBLE THE AMOUNT OF COPPER** ***in Existing Raceways***



NEW

3 No. 8 Type T Carry 41 Amps.

Illustration shows ½" conduit

Under present conditions there is urgent need for an economical and quick way of adding to the current carrying capacity of branch circuit conduits already installed. Increasing numbers of electrical appliances, air conditioning units and other equipment call for greater load on these branch circuits.

A simple solution to this problem is to replace present wiring with CRESCENT SYNTHOL Type T (formerly Type SN), which offers an easy and low-cost way approximately to double the current carrying capacity of the existing raceway.

An even greater increase in carrying capacity can be secured by wiring with CRESCENT Type TW in place of lead covered cable in wet locations.

Write for Descriptive Folder on SYNTHOL Type T and Type TW

CRESCENT INSULATED WIRE & CABLE CO.

TRENTON, N. J.

CRESCENT
WIRE AND CABLE

frequencies of 10,000 cycles and above. Discusses outer jackets or sheaths commonly used as insulating material which include plastex, polyethylene, neoprene or Buna S compounds. Tables, containing common types of high frequency cables, are also given. Simplex Wire & Cable Co.

26 SUBSTATION MULTIPOLE SWITCHES: Bulletin 4601 pictures and describes the improved MB-39 pole top and outdoor substation multipole switches in ratings from 7.5 to 161 kv. and ampere capacities from 400 to 1,200. They can be either manual or motor operated. Close-up photographs show the "twist-like-a-wrist" blade movement mechanism, and contacts at both blade ends without the use of shunts or braids. Dimensions are given. Post type insulators are also furnished. Delta-Star Electric Co.

27 MAINTENANCE PAINT: Bulletin gives complete information on a new, chemical-resistance maintenance paint, with illustrations of typical jobs showing how this quick-drying, protective coating is applied to heated, wet, and porous surfaces of all kinds. Photographs of test strips demonstrate the protection provided by a single coat against hot acids, alkalis and water. Other distinctive features are explained in detail. Peninsular Chemical Products Co.

28 RECORDGRAPH: Booklet, originally dedicated to the Armed Forces, shows the many uses of recordgraph during the war. Contains documentary news stories of the war—in the Atlantic, the Pacific, Europe and at home—as recorded on-the-spot by the Radiograph and broadcast by American and other radio stations. Frederick Hart & Co., Inc.

29 TECHNICAL DATA FILE: A new technical data file gives practical information on the use of highly refined white mineral oils for the lubrication of precision and other special electrical equipment both during manufacture and utilization. It tells how and why these oils guard electric motors, clocks, shavers, radio tubes as well as circuit breakers, condensers, transformers, turbines and recoil mechanisms against breakdowns due to deterioration, rust and corrosion. This is of a standard file cabinet size and may be used as a folder for filing all essential data on the subject. L. Sonneborn Sons, Inc.

30 MAGNETIC RECORDERS: Booklet entitled "Magnetic Recording Comes of Age" discusses the developments in this field. Illustrations of various types of magnetic recorders are shown. Advantages of this type of recording over other methods are outlined in detail. The Brush Development Co.

31 MISCELLANEOUS ELECTRICAL EQUIPMENT: Catalog contains a wide variety of electrical equipment for buses, steam and electric railway cars, locomotives, and industrial haulage systems, including many products for industrial feeder and high-tension power distribution lines. Also includes a line of machines for armature winding, banding, and slotting. A variety of winding tools is given. Illustrations, drawings and dimension diagrams present salient construction features. Electric Service Mfg. Co.

32 INSTRUMENTS: Catalog 1105 illustrates and describes a variety of indicators, recorders, controllers, electric and air

THE "essentials" for a trout-stream fisherman are rubber hip-boots, fly-rod, flies . . . and experience! Any substitutes are handicaps. You need trout equipment . . . and trout technique.

That expresses MOSINEE philosophy in terms of creative essential papers for industry. Experienced MOSINEE paper technicians find out *what* the function of paper must be in your product . . . as well as *how* that paper can be adapted to your processing technique. And MOSINEE doesn't offer substitutes . . . nor try to adapt a standard stock paper that merely approximates the chemical and technical characteristics your paper needs.

That's why so many manufacturers find MOSINEE such a dependable source for production of essential industrial papers.

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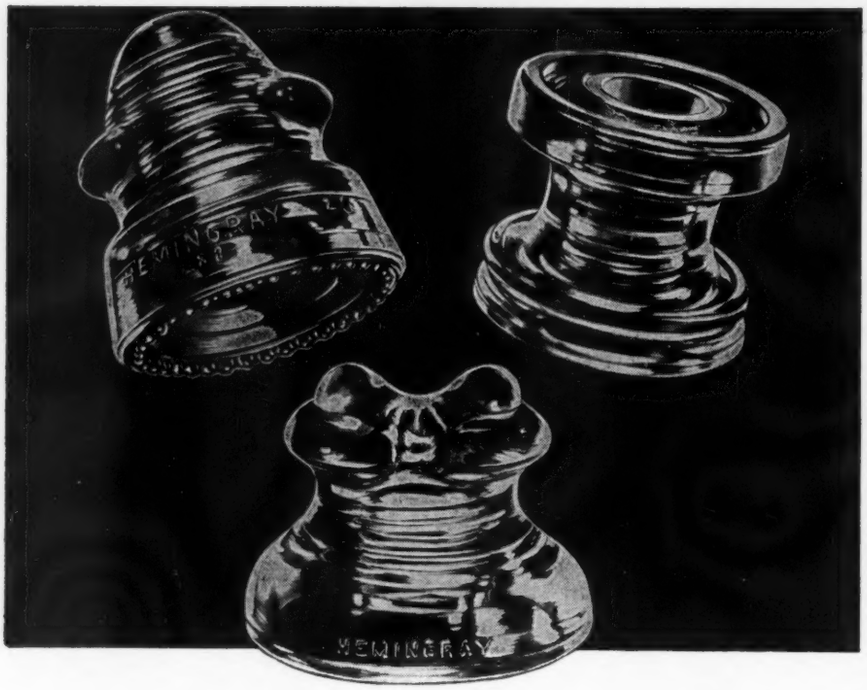
MOSINEE · WISCONSIN

Essential Paper Makers

Please address your letter "Attention Dept. B"

HEMINGRAY INSULATORS

Favorably Known Since 1870



Power Insulators You Can Rely On!

Hemingray Insulators are made as you would like to have them made. Under exacting laboratory control!

Every batch of glass—every lot of moulded insulators is checked *hourly,* with various precision instruments.

That's why Hemingray Insulators are so free from flaws, so uniform in quality, so dependable.

There are ten Hemingrays for Primary Power distribution for voltages from 2,300 to 15,000 and manufactured in accordance with suggested specifications of the Edison Electric Institute.

There are ten Hemingrays for Secondary Power distribution with heights ranging from $2\frac{15}{16}$ to $5\frac{1}{32}$ inches and diameters from $2\frac{1}{4}$ to $3\frac{1}{4}$ inches.

Investigate! Hemingrays are sold by principal jobbers and are manufactured by Owens-Illinois, Hemingray Division, Muncie, Ind.

OWENS-ILLINOIS

HEMINGRAY INSULATORS

Telephone-Telegraph

Export Agents: International Standard Electric Corporation, New York City

operated. Includes radiamatic accessories, control accessories, a line of multiple key switches and cabinets. Partial list of chart and scale ranges is shown. Drilling and mounting dimensions are also given. Brown Instrument Co.

33 EROSION PREVENTION: A 12-page report discusses prevention of erosion from water in motion by the use of product called "Dibecote." Covers such topics as air impingement, improvement of condenser tube life, corrosion, electrolysis, dezincification, etc. The Debevoise Co.

34 BRAZING FURNACES: Bulletin 210 features mesh belt conveyor furnace, designed chiefly for high temperature copper brazing. Can also be employed for low temperature, silver brazing, bright annealing, and sintering of powder metals. Illustrations and specifications with tables are furnished. Lindberg Engineering Co.

35 FLASH-BUTT WELDING: Folder outlines types of flash-butt welding performed by this manufacturer. Tells that it is equipped to turn out all kinds of welded assemblies, build complex units from flash-welded rings by means of hand and automatic welding; produce frames and assemblies for both a.c. and d.c. motors with ratings above 1 hp. Illustrations are given showing steps in operation. The American Welding & Mfg. Co.

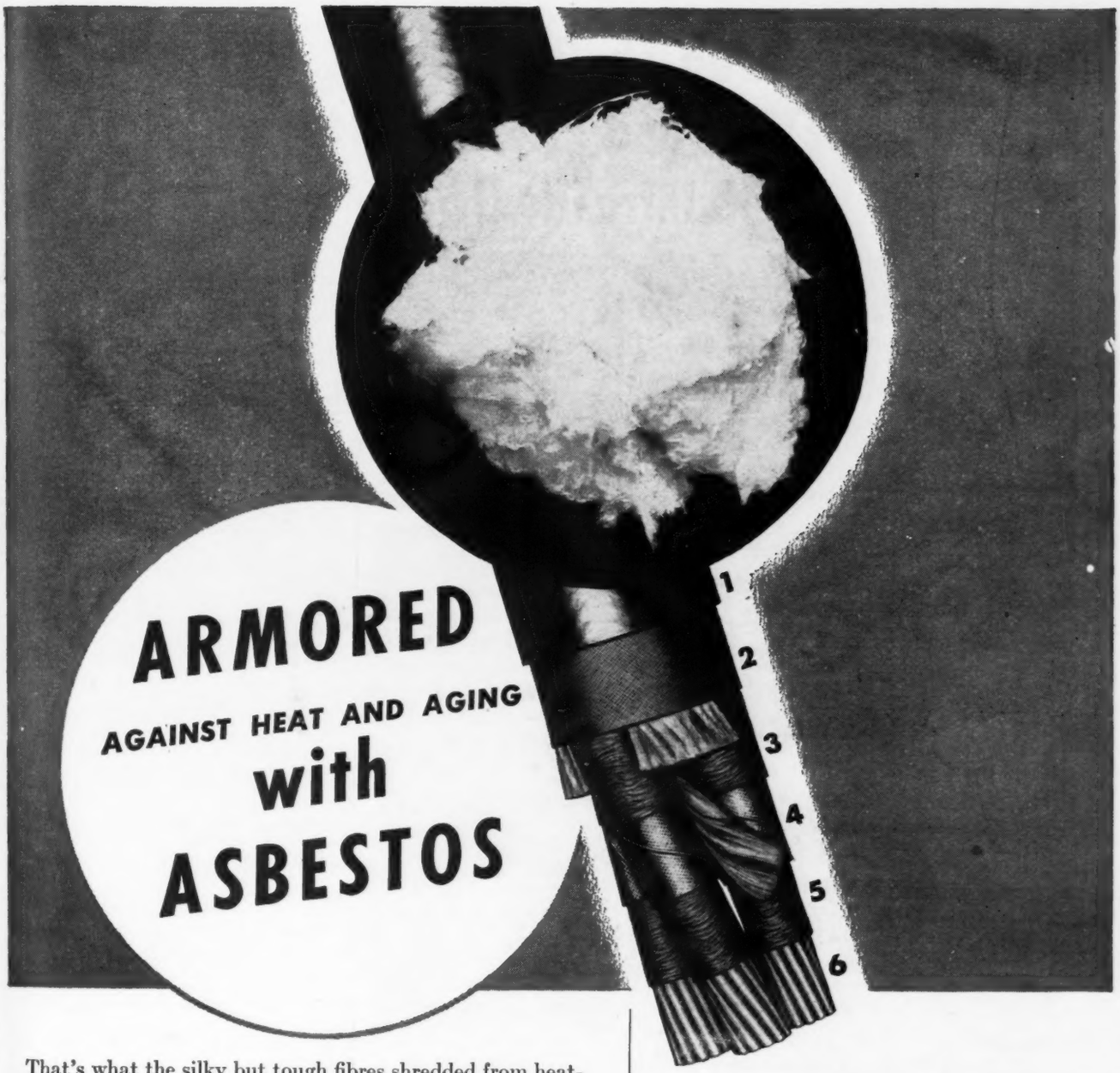
36 RADIO TUBES: Booklet gives typical operating conditions, characteristics and tube base diagrams for more than 450 types of electron tubes used in radio receiver and industrial electronic applications. Tube base diagrams are also available separately, printed on card stock and punched for wall mounting. Sylvania Electric Products, Inc.

37 STANDARD FLASH WELDERS: An 8-page technical and descriptive bulletin describes line of standard flash welders. Phantom and detail views are used to illustrate features of work performed on all models, from 20 to 250 kva., which make the line of machines adaptable to a wide range of flash and butt welding applications. Choice of manual, semi-automatic or full automatic control is available for either air or hydraulic clamping or mechanical, or hydraulic upset operation. Full hydraulic operated models are designed to permit the operator to intercede at any point in the automatic welding cycle and take over the control. Progressive Welder Co.

38 SOLENOID VALVES: Bulletin 461 describes V5-200 solenoid valve, designed for use with CO_2, air, water, hydraulic fluids and other media. All parts in contact with the media are made of stainless steel. The V5-200 is available for a.c. or d.c. operation, intermittent or continuous duty, rated at 10 watts maximum. Illustrations and specifications and drawings are given. Allied Control Valve Co., Inc.

39 COLD CATHODE LIGHTING: Folder entitled "Flolite and Glare Reduction" contains many helpful hints on good lighting. Contains lighting fundamentals covering such subjects as glare, specular reflection, brightness, etc. In back of folder brightness measurement chart of lamps is given. Mobecco, Inc.

40 PACKING CASE LINERS: A 16-page, illustrated brochure covers the application of synthetic impregnated, waterproof, sealed case liners, and describes the



ARMORED
AGAINST HEAT AND AGING
with ASBESTOS

That's what the silky but tough fibres shredded from heat-proof, fireproof, age-resistant crude asbestos do for Rockbestos A.V.C. wires and cables. They actually *armor* them against baking heat, oxidation, rotting fumes, oil, grease, and even flame, with insulation that is *practically indestructible!*

This *permanent insulation* gives you cables that guarantee dependable operation of induced draft fans operating in high ambient temperatures over boilers—coal grinding mills, exhausters, boiler feed pumps, forced draft fans, ash slush pumps—or any equipment that must function without failure even though it has to operate under severe conditions.

For *permanent installations* that practically eliminate maintenance and replacement, use Rockbestos A.V.C. and All-Asbestos wires and cables—in 600 to 5000 volt ratings—single or multi-conductor—plain, lead sheathed or armored. Send for a catalog.

Rockbestos Products Corp., 131 Nicoll Street, New Haven 4, Conn.

ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

NEW YORK BUFFALO CLEVELAND CHICAGO PITTSBURGH ST. LOUIS
LOS ANGELES SAN FRANCISCO SEATTLE PORTLAND, ORE.

A PERMANENT ROCKBESTOS CONSTRUCTION THAT ASSURES LONG-LIVED SERVICE

The Rockbestos A.V.C. 600 Volt Power Cable illustrated has individuals insulated exactly like our single conductor Power and Motor Lead Cables (maximum operating temperatures 110°C.) minus the outer braid:

1. A tough impregnated asbestos yarn braid, resistant to heat, flame, moisture, oil, grease and fumes.
2. Tape binds jute fillers (asbestos if required) and cabled assembly securely.
3. Heat, flame and moisture resistant impregnated felted asbestos insulation that won't dry out, crack or rot.
4. Asbestos-protected varnished cambric for high dielectric strength and added moisture resistance.
5. Inner wall of impregnated felted asbestos withstands conductor-heating overloads and won't bake brittle or burn.
6. Conductors are perfectly and permanently centered in helically applied non-flowing insulation that provides greater current carrying capacity.

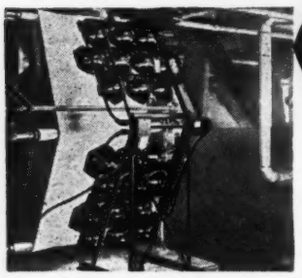
One of 125 different constructions designed for severe or unusual operating conditions by Rockbestos.

You can do jobs like these BETTER and FASTER with Infra-Red!

DRYING OF FINISHES

Infra-Red cuts hours from drying or baking time in the finishing room. Process is equally adaptable to small parts or to complete automobile bodies or chassis.

PRESHRINKING TEXTILES



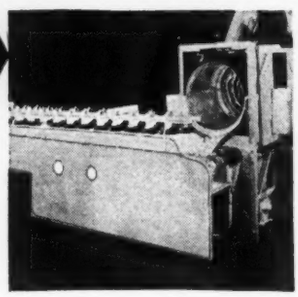
In the Sanforizing process of preshrinking textiles, Infra-Red speeds up production as much as 30% to 40%. Equally effective results are obtained in drying paper.

TO HELP BOOST POWER SALES...

Wabash - Birdseye is sponsoring ads like this in major industrial publications . . . stimulating interest in wider use of load-building Infra-Red.

DEHYDRATING FOODS

This normally slow process is greatly accelerated by the use of Infra-Red. Printed labels, for food packages and containers too, are dried quickly with Infra-Red.



(Photos courtesy General Motors Corporation, Pontiac Div.; Fostoria Pressed Steel Corporation.)

FOR BEST RESULTS WITH INFRA-RED

in baking, drying, preheating, or dehydrating applications, come to Wabash. Wabash-Birdseye Infra-Red Lamps have the special tungsten filaments that provide uniform distribution of radiant energy . . . and the "Superlok" bases that the highest tunnel temperatures cannot loosen. *And* . . . Wabash is ready to help you engineer each application to your requirements. Write to

WABASH CORPORATION
345 Carroll Street, Brooklyn 31, N. Y.
A Subsidiary of Sylvania Electric Products Inc.

WABASH-BIRDSEYE
FIRST IN INFRA-RED

steps in applying this product. Physical characteristics with technical details resulting from tests of the material are given. Protective Coating Corp.

41 CONTROLLED ATMOSPHERES FOR HEAT TREATING: Bulletin 190 describes and illustrates four distinct types of neutral heat treating atmospheres, tells how they are produced, cost per 1,000 cubic feet of each, and lists the many applications for which each may be employed. Applications include the hardening of high carbon, alloy, or high speed tool steels totally free from scale carburization, or decarburization; brazing; bright annealing of ferrous and non-ferrous metals; bright tempering; and other similar operations. Illustrations show different types of equipment used in these processes. Several schematic flow diagrams give pictorial view of how each type of system works. Lindberg Engineering Co.

42 LUBRICANTS: Booklet gives picture story of Alchlor Process. Also includes operating characteristics and advantages of this particular lubricant. Among other things, contains operating records of a 40,000-kw. steam turbine. Colored illustrations showing steps of process are included. Gulf Oil Corp.

43 RELAYS AND TIMERS: A 48-page catalog features relays and timers for a variety of applications. Each type of relay and timer is described in detail, showing various adaptations that may be obtained. Detailed information is included for each individual type of relay. Supplementary information such as that pertaining to contacts, frames, etc., is printed separately. The remainder of the catalog is devoted to information on coils, styles of mounting, housings, type designation system used, magnetic structures and relay applications. Struthers-Dunn, Inc.

44 OUTDOOR ELECTRIC METERING AND INSTRUMENT TRANSFORMER ENCLOSURES: Catalog 18 gives complete data covering outdoor enclosures for meters and transformers; discusses design features, materials and finishes used, types of windows each contains; prices and terms. Illustrations and drawings show construction details. F. D. Kees Mfg. Co.

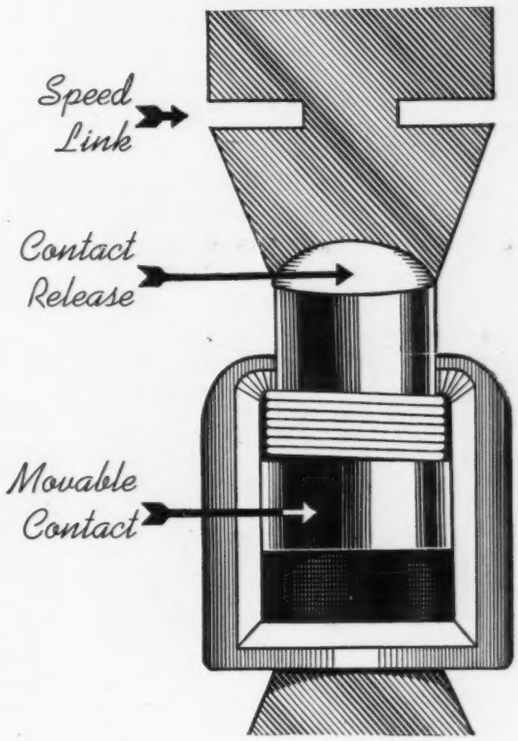
45 STAGE AND LIGHTING CONTROL SWITCHBOARDS: Catalog SB-45 attempts to present an outline of the more popular types of equipment of modern-day stage and lighting control switchboards, used to meet the requirements of a specific installation. Each type of lighting control is discussed in detail, showing the variety of control equipment involved. Hub Electric Corp.

46 OVERHEAD LINE MATERIAL: Bulletin 39A features a diversified line of overhead line material for electric railways, mines and industrial plants. Illustrations are shown presenting actual installations. Cutaway drawings show construction features. Drawings of each item give dimensions. Albert & J. M. Anderson Mfg. Co.

47 FUSES: Here is a handbook on fuses, designed for maintenance men, electricians, and contractors. Contains helpful and practical information covering methods of selecting proper size fuses for various circuits. Handbook is illustrated with charts, diagrams, and drawings. Bussmann Mfg. Co.

The 3-in-1 fuse with Therm-A-Trip

How it works—



When a short circuit occurs, one or more of the necks of the Speed Link are blown, instantaneously opening the circuit, and preventing damage to wiring or equipment.

Trion's Therm-A-Trip also opens the circuit when safe operating temperatures, whether surrounding or load, are exceeded. It matches its thermal capacity to the motor or transformer it protects.

When a safe overload is exceeded, the Therm-A-Trip, with its Contact Release and Movable Contact, absorbs heat, giving an extra long time-delay. Then the Contact Release melts, and the Movable Contact, driven by its heavy spring, opens the circuit with the efficiency of a circuit breaker.

Fuse economy with circuit breaker efficiency

Newburyport, Massachusetts

Chicago Dallas St. Louis Omaha Kansas City Denver Los Angeles San Francisco Seattle Minneapolis

NEWS ABOUT PEOPLE

Michel Given New Duties; Skinner Sales Director

Charles E. Michel, vice-president in charge of sales of Union Electric Co., St. Louis, on April 15 will assume duties relative to the executive management of

C. E. Michel

the company. Merrill E. Skinner, who recently resigned as vice-president of the Buffalo, Niagara & Eastern Power Corp., becomes director of sales for the company, succeeding to Mr. Michel's responsibilities in the sales department.

President J. W. McAfee, in announcing the change, said the growth of Union Electric system in recent years has increased the work of executive management to the point where Mr. Michel's many years of experience and knowledge of the company are needed in the new capacity. He will retain his title as vice-president.

Mr. Michel was originally employed in 1907, as manager of the company's automobile department. He became sales manager in 1918 and vice-president in charge of sales in 1935. He was elected to the board of directors in 1941, in which capacity he will continue to serve. He has served as president of the St. Louis Electrical Board of Trade and of the Missouri Association of Public Utilities. In 1933 he won the James H. McGraw Award Medal for Cooperation for his creative leadership in coordinating the development of the electric market in St. Louis.

Mr. Skinner was employed by Westinghouse from 1915 to 1922 and from there went to the Duquesne Light Co. of Pittsburgh as assistant to the vice-president and general manager, later becoming commercial manager. He was affiliated with the Niagara Hudson System companies from 1927 to 1936 at which time he was made vice-president of the Buffalo Niagara & Eastern Power Corp. Mr. Skinner is a graduate of the University of Wisconsin and has both a bachelor of arts degree and bachelor of science in electrical engineering. He served as chairman of the Edison Electric Institute

M. E. Skinner

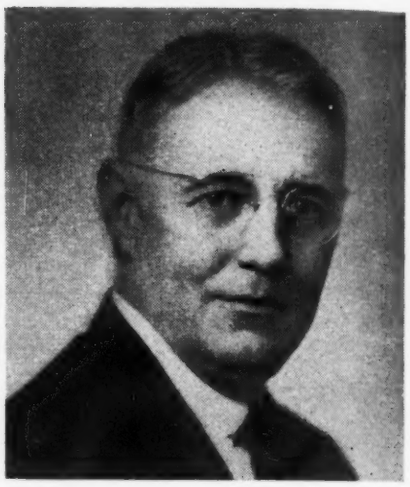
Committee which organized the Better Light—Better Sight program and was also the recipient in 1935 of the James H. McGraw Award Medal for Cooperation.

•

▶ ARTHUR V. MCKENNA has been appointed merchandise manager of the Weymouth (Mass.) Light & Power Co., a New England Power System subsidiary. He joined the company in 1932, and from 1940 to 1942 was located in the Randolph-Holbrook division in both a sales and public relations capacity. Since then he has been assistant to the superintendent of the Weymouth company.

Georgia Power Co. Elects Clapp Vice-President

Edwin M. Clapp, manager of the industrial power division of the Georgia Power Co., Atlanta, has been elected a vice-president of the company and appointed Columbus division manager, succeeding T. S. Sloan, who has been



E. M. Clapp

granted an indefinite leave of absence because of illness. Mr. Sloan resigned his position following a connection with the Georgia Power Co. and its predecessors that dates back to 1908. He had been stationed in Columbus since 1937, and had been a vice-president since 1940.

Mr. Clapp has been employed by the Georgia utility since 1928, engaging in power sales and engineering work. He is a native of Massachusetts and before joining the Georgia Power Co. in 1928 he was identified with the General Electric Co. and Fairbanks, Morse & Co. His first assignment in Georgia was as an industrial engineer at Macon. Later he was appointed assistant manager of the industrial power division and in 1937 manager.

Mr. Clapp is recognized as an authority on industrial power engineering. He has written numerous papers on the subject and is a member of several national committees.

•

▶ ALEX SPEER has been appointed director of St. Petersburg (Fla.) utilities, succeeding JAMES GIBSON, retired. Mr. Speer formerly served the city in the capacity of director of post-war planning and in charge of its technical services. Mr. Gibson had been in St. Petersburg municipal service since 1924. Prior to his connection in the South, he was assistant electrical engineer for Westinghouse, Church, Kerr & Co., New York. Since his nearly 23 years of city service began in St. Petersburg, Mr. Gibson has been

Ryerson Stocks Equally Handy

Steel of all kinds at your finger tips, almost as convenient as the seasonings on a well stocked shelf! The right kind, the exact amount, in easy reach.

That in substance is Ryerson Steel-Service, supplied by eleven strategically located Ryerson plants. The exact steel you want, cut or otherwise prepared just the way you want it, delivered promptly, "right from the shelf."

Even now, with stocks short in many sizes, you can more often find the steel you need at Ryerson. And stocks are improving daily.

Moreover, Ryerson technical men are available to work with you on any problem of selection or fabrication.

Ryerson stocks normally include more than 10,000 sizes, shapes and kinds of steel, all described in the current Ryerson Stock List and Data Book. Copies have been distributed, but if you do not have one we will be pleased to send it to you.

No matter what kind of steel you need, contact Ryerson *first*—your best source for prompt steel delivery.

PRINCIPAL PRODUCTS

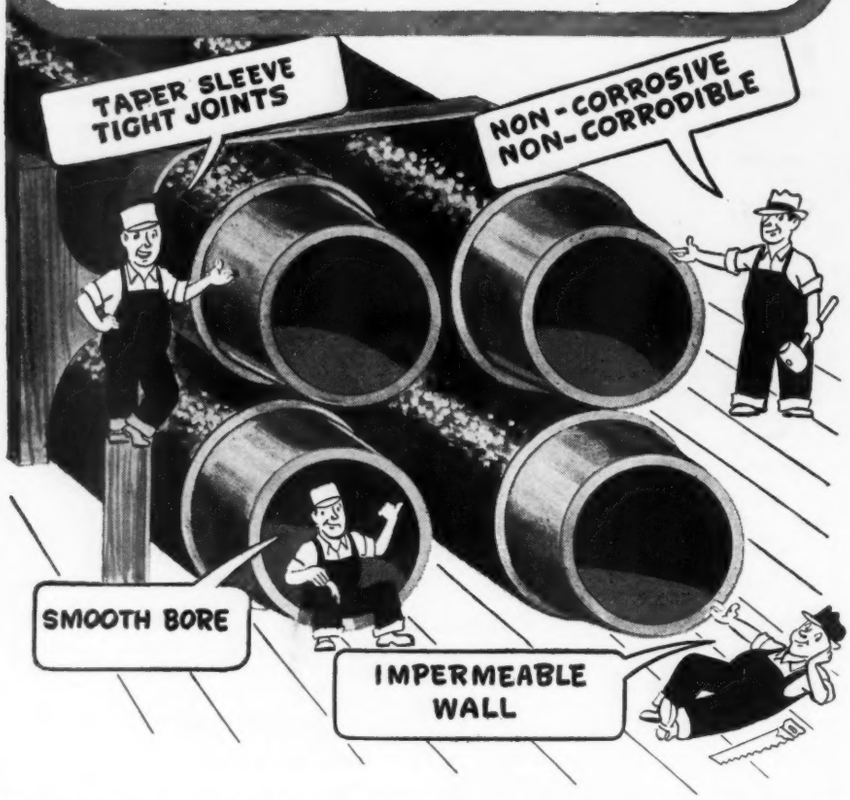
- Bars—
  - hot and cold rolled
  - alloy steel
  - reinforcing
- Structurals
- Plates—
  - Inland 4-Way Floor Plate
- Sheets
- Strip Steel
- Mechanical Tubing
- Boiler Tubes and Fittings
- Allegheny Stainless—
  - sheets, plates, shapes, bars, tubing, etc.
- Tool Steel
- Wire, Chain
- Bolts, Rivets
- Babbitt
- Solder
- Welding Rod
- Metal Working Tools and Machinery, etc.

JOSEPH T. RYERSON & SON, INC.

Steel-Service Plants at: Chicago • Milwaukee • Cleveland • Cincinnati • St. Louis • Detroit Philadelphia • Pittsburgh • Buffalo • Boston • New York

RYERSON STEEL

FEATURES TO LOOK FOR IN A BETTER CONDUIT



*ORANGEBURG'S exceptionally smooth surface and non-abrasive material prevent scoring or abrasion of sheath, when entering the duct—and also as the cable creeps under load variations.

With ORANGEBURG, there is less friction as cables are pulled into ducts—keeping tension low, preventing harmful strains, and making longer pulls possible.

ORANGEBURG'S taper sleeve joints and impermeable walls prevent the infiltration of ground water and corrosive elements. ORANGEBURG materials are non-corrosive and non-corrodible — contain nothing to injure cable sheath and are themselves highly resistant to the action of ground waters and industrial wastes.

Your free copy of the ORANGEBURG catalog contains much interesting information. Write for it today!

THE FIBRE CONDUIT COMPANY • ORANGEBURG, N. Y.
Graybar Electric Co., Inc. • *Distributors* • General Electric Supply Corp.

ORANGEBURG FIBRE CONDUIT

*Reg. U.S. Pat. Off.

THE FIBRE CONDUIT CO. ORANGEBURG PAT. OFF. ORANGEBURG, N.Y.

ORANGEBURG

WITH 50 YEARS EXPERIENCE IN THE MANUFACTURE OF NON-METALLIC CONDUIT AND PIPE, SERVES THE POWER AND LIGHT, TELEPHONE, GENERAL CONSTRUCTION, CHEMICAL, PETROLEUM, PLUMBING AND BUILDING SUPPLY FIELDS WITH ELECTRICAL FIBRE CONDUIT . . . ELECTRICAL UNDERFLOOR DUCT SYSTEMS . . . AND FIBRE PIPE FOR NON-PRESSURE USES.

successively construction engineer, superintendent of streets, superintendent of power, assistant director of utilities and director.

•

W. R. Weise Directs Electric Distribution Engineering

Appointment of W. R. Weise as superintendent of distribution engineering of the Cincinnati Gas & Electric Co. has

W. R. Weise

been announced. Mr. Weise, who has been supervisor in charge of voltage control and rearrangement in electric distribution engineering, succeeds Frank E. Sanford, who resigned to join the editorial staff of ELECTRICAL WORLD in the Chicago office.

A native of Cincinnati and a graduate of the University of Cincinnati with a degree in electrical engineering in 1927, Mr. Weise started in the underground department in 1922 as a cooperative student, later moving to the test department.

In 1926 he joined the electric distribution department, while still a junior in school and upon his graduation in 1927 became a full-time employee. He was placed in charge of the rearrangement program started in 1927 to increase the system's capacity to take care of the increasing load.

Mr. Weise is a member of the Engineering Society of Cincinnati, the Ohio Society of Professional Engineers and Eta Kappa Nu, honorary electrical fraternity.

•

▶ NELSON B. PHILLIPS has been appointed superintendent of the meter department of the Buffalo Niagara Electric Corp., succeeding Earle A. LeFever, retired. The general supervision of meter work in what was formerly the western division of the Niagara Hudson Power Corp. has been transferred to Mr. Phillips's office and will be handled in addition to the operation of the Buffalo ter-

Polatrol

FLEXIBLE
ECONOMICAL
TROUBLE-FREE

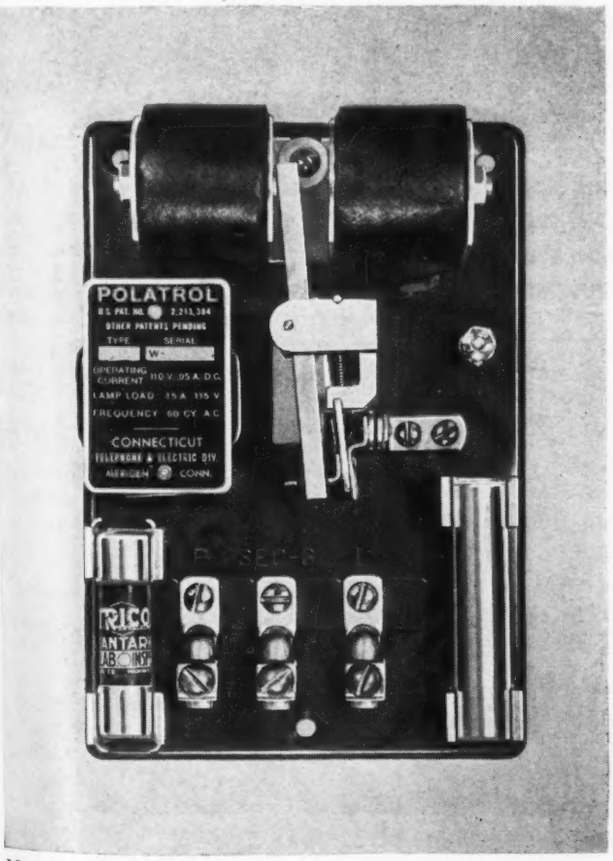
CENTRALIZED STREET LIGHTING CONTROL

See it at the International Lighting Exposition
Chicago, April 25-30, 1946

DON'T miss the model replica of a *Polatrol* street lighting installation on exhibit at the Connecticut Telephone & Electric booth. See it in action—note its advantages and then specify *Polatrol* for centralized street lighting. *Polatrol* is an efficient and economical means of controlling multiple street lights and off-peak services. It is applicable to all types of distribution systems. Years of service in actual street lighting systems show that *Polatrol* has these advantages:

1. *Low initial installation costs*
2. *Low maintenance costs*
3. *Efficient and economical methods of operation*
4. *Trouble-free operation*
5. *Flexibility*
6. *Safety*

POLATROL operates by impressing polarized direct current on pilot wires. It may be activated automatically by photo-electric cells or time clocks . . . or manually by central station personnel. For complete information visit the Connecticut Telephone & Electric Booth 121 at the Lighting Exposition, or write direct to: Connecticut Telephone & Electric, Meriden, Conn.



Master Polatrol relay, which is installed on the control panel board for operation of the midnight or all-night burning lamps.

—And Don't Miss This First In

FLUORESCENT LIGHT CONTROL

It's the new 3-way instant-starting transformer—also on exhibit in our Booth 121.

Connecticut
TELEPHONE & ELECTRIC
Division of Great American Industries, Inc.
MERIDEN CONN.

INSTRUMENTS YOU CAN AFFORD TO USE

...on everyday jobs

INEXPENSIVE

ACCURATE

RUGGED

EASILY REPAIRED IN CASE OF MISUSE

Hundreds of production line testing jobs and field investigations, in addition to laboratory tests require dependable instruments of a type that don't have to be kept under lock and key because of their extreme delicacy and high cost. Shallcross answers this need with many types of

BRIDGES — DECADE BOXES
RESISTANCE STANDARDS
DECADE POTENTIOMETERS
HIGH-VOLTAGE TEST EQUIPMENT, etc.

These instruments are accurate for every commercial and laboratory need up to the point of the most exacting research in pure physics. They are rugged, easy to operate and decidedly moderate in price. In case of misuse, they can quickly be repaired to full efficiency by any reasonably competent individual without the expense and delay of returning them to the factory.

WRITE FOR BULLETINS

Bulletin 810, Shallcross Resistance Standards
Bulletin 825, Resistance Decades
Bulletin D-1, Bridges
Bulletin LRT, Low Resistance Test Sets
Bulletin G, Electrical Measuring Apparatus for schools and colleges

SHALLCROSS MFG. CO., DEPT. EW-46, Collingdale, Pa.

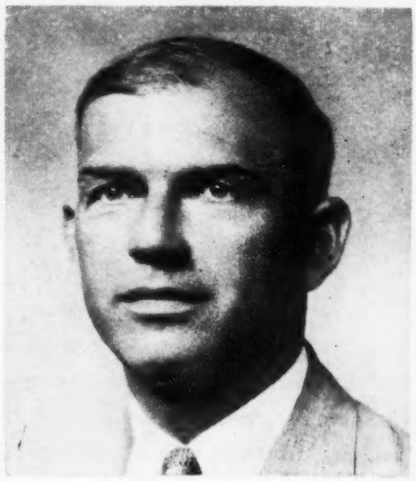
SHALLCROSS Electrical Measuring Apparatus • AKRA-OHM Resistors • Precision Switches • Electronic Engineering

ritory. Mr. Phillips has been active in meter work since 1909 when he joined the Buffalo organization.

•

C. L. Longanecker Assigned New Engineering Duties

C. L. Longanecker, formerly superintendent of overhead lines of the Virginia Electric & Power Co., Richmond, has been made supervisor of overhead lines of the company's entire system.



C. L. Longanecker

Mr. Longanecker has been a member of the Vepco organization for 21 years, having started with the company in Petersburg, Va., in 1925 as distribution engineer and having been made superintendent of the electric department in Petersburg five years later.

For many years a member of the Vepco system engineering committee, Mr. Longanecker has been active in developing a manual of standard line construction and has done much to provide the information necessary in order that all lines may be constructed on a uniform basis, thus keeping down costs and at the same time assuring reliability and safety.

Mr. Longanecker has spent many hours teaching classes in electricity in addition to the groups he has taught in his own department. His enthusiasm and ability give assurance that he will stimulate system-wide interest in the construction of overhead lines, now an active part of the Vepco expansion program.

•

▶ Thomas J. Rouner has been elected vice-president of the New England Power Co., Connecticut River Power Co., and Bellows Falls Hydro-Electric Corp., wholesale subsidiaries of the New England Power System, with headquarters at Boston. He joined the New England system in 1927 and spent 15 years as principal assistant in the hydro-economics department. He returned last fall after nearly five years' war service to the utility

Introducing . . . A PHOTOELECTRIC CONTROL FOR MULTIPLE STREET LIGHTS BY FISHER-PIERCE

NEW LIGHT ON THE PROBLEM OF STREET LIGHTING

The Fisher-Pierce Company — specialists in electronic applications — announce a new achievement — a simplified Automatic Photoelectric Unit for Multiple Street Light Control.

The interest on the part of electric utilities in such a development will center around these features: —

1. **Flexibility** — individual street lights can be connected directly to 117-volt distribution lines.
2. **Lower Costs** in service and maintenance.
3. **Quality** of lighting service secured.

With FISHER-PIERCE PHOTOELECTRIC CONTROL it is possible to preset the value of illumination at which it is desired to turn on the lights . . . and lights so controlled will go on at that value of illumination day after day regardless of specific location, weather conditions, or obstacles.

1. **Technical Characteristics & Features** — This control operates *dependably* down to less than 1 foot-candle. It has a built-in differential and time delay to avoid operation by lightning, clouds or cycling — absolute minimum of components —
2. **Maintenance Procedure** — Routine maintenance necessary only once per year — In addition to its technical advantages, plug-in replacement eliminates the need for service on the pole and permits full utilization of skilled technician's time.
3. **Installation** — Heavy galvanized mounting bracket fastens directly to distribution pole.

This new type control has already attracted the attention and admiration of farsighted lighting engineers. Its compactness, its ease of installation, and its performance, permit a flexible system with distinct operational economies. Fisher-Pierce has these controls in production. A number of units are already in use.

SAMPLES IMMEDIATELY AVAILABLE FOR TEST

FISHER-PIERCE COMPANY

82 CEYLON STREET BOSTON 21, MASSACHUSETTS

Protect Now with GRINNELL MULSIFYRE

Breakdown in a 16,000 k.v.a. transformer . . . severe internal arcing . . . relief disc blows out . . . oil is violently ejected . . intense fire envelopes nearby equipment . . . two adjoining transformers let go and add to the fury of the flames. It took a 1½-hour battle to subdue the fire — and $50,000 to replace and repair the damage!

A Grinnell Mulsifyre System now protects the new equipment – as it does the installations of many other public utility transformer stations.

Wide acceptance of Grinnell Mulsifyre Systems is based on a proved effective principle—in which blazing oil is emulsified with a driving spray of water. The emulsion formed by the water spray is fire-extinguishing—the fire goes out in a few seconds—reignition is prevented.

There is absolutely no conductivity along the discharge of a Mulsifyre projector when spray strikes conductors carrying high voltages. Mulsifyre Systems are permanently installed – are constantly on guard when operated automatically – or may be operated manually.

Recommended by Underwriters' Laboratories for use in extinguishing fires in flammable oils immiscible with water, wherever such oil is a fire hazard – in transformers and other oil-filled electrical equipment.

Don't wait for fire to strike! See that your equipment has this 24-hour-a-day protection from now on. Grinnell engineers will help you plan protection for your specific needs.

GRINNELL COMPANY INC.

Executive Offices, Providence 1, R. I.
Branch offices in principal cities.

GRINNELL *Mulsifyre*

AUTOMATIC FIRE PROTECTION

group above mentioned as head of the department, succeeding Arthur E. LaCroix, now executive vice-president of the New England Power Service Co.

•

M. C. Wilt Made President of Curtis Lighting, Inc.

Melvin C. Wilt, formerly executive vice-president and general manager of Curtis Lighting, Inc., was elected president of the company at the last meeting of the board of directors.

M. C. Wilt

Mr. Wilt replaces Darwin Curtis who becomes chairman of the board of directors. Kenneth Curtis, formerly chairman of the board, becomes chairman of the advisory committee. Mr. Wilt's election marks the first time that the position of president has been held by any other than a member of the Curtis family.

Mr. Wilt started with Curtis in 1928, as a sales representative for Cleveland, Ohio, territory, and later moved to Toronto, Canada, to set up and organize Curtis Lighting of Canada, Ltd. After serving as managing director of the Canadian company for ten years, he returned to the United States company as vice-president and general manager, in 1940. During the war, Mr. Wilt served as a lieutenant-commander in the Supply Corps, USNR, but returned to Curtis Lighting on being released from active duty in November, 1944.

He has been in the electrical industry since 1922. Before joining Curtis Lighting, he was employed by the General Electric Co. at Nela Park, Ohio; the Ohio Power Co. at Lima, and the Appalachian Electric Power Co. at Huntington, W. Va.

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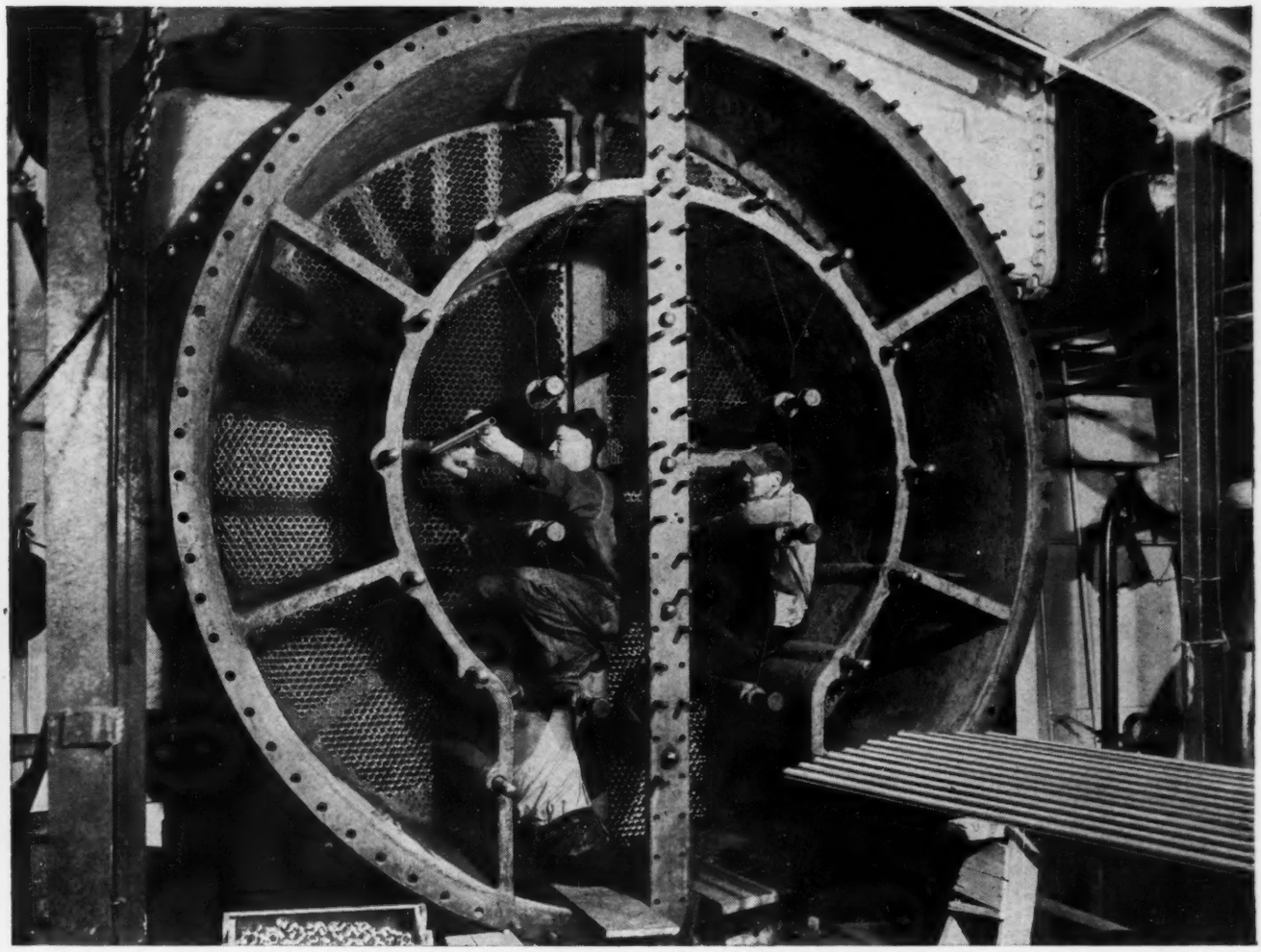
► CHESTER S. ALLEN has been elected president of Lockwood Greene Engineers, Inc., New York, N. Y., succeeding the late Albert L. Scott. Mr. Allen was formerly vice-president of the company, in



Installing Anaconda Condenser Tubes of Ambraloy 927 in condenser at The Westport Station of Consolidated Gas Electric Light and Power Co. of Baltimore. Tubes are 18 feet long, 1 inch O.D., .049 inch wall.

Coolant—Harbor-Polluted Water

Tubes—ANACONDA AMBRALOY 927

THIS CONDENSER at the Westport Station of Consolidated Gas Electric Light and Power Co. of Baltimore, has 28,950 square feet of condensing surface, provided by 6,250 tubes 18 feet long. Tube life is accordingly a major factor in economy of operation.

The water available for cooling is a combination of fresh and salt water, combined with harbor pollution. Under similar conditions in other seaboard power plants, Anaconda Ambraloy 927 (Arsenical Aluminum Brass) has proved superior to other alloys. Hence the use of this type of tube in the condenser illustrated.

A pioneer in the development of condenser tube materials, The American Brass Company now produces 11 standard and several special alloys of this type. Assistance in selecting the one best suited to meet a specific set of conditions is offered by our Technical Department.

For detailed information on Anaconda Condenser Tubes, write for Publication B-2. 46173

ANACONDA

Anaconda

CONDENSER TUBES

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

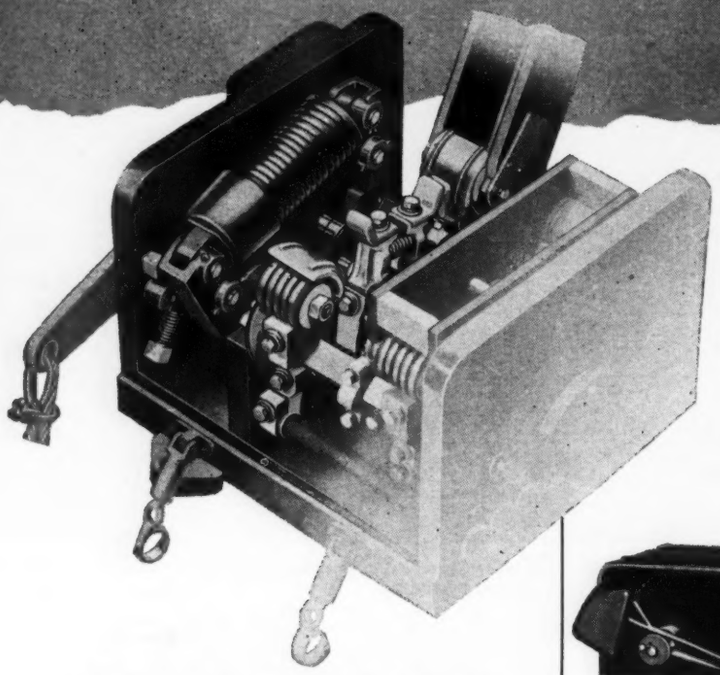
In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

Improved

PROTECTION *for* CRANE HOISTS

AGAINST OVERTRAVEL

***with* EC&M SAFETY LIMIT STOP**

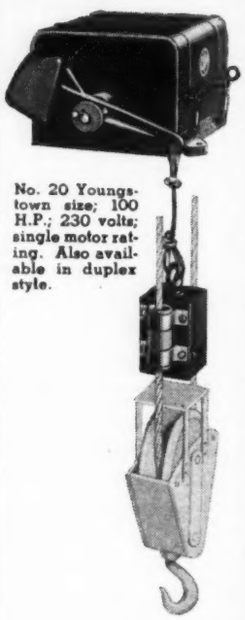


1 No lubrication required—Oilite bearings (with super-oilite on main bearings) are self-lubricating and long-lived.

2 Compact—easy to mount—Reduced, overall dimensions—three convenient mounting holes, and but one suspended weight.

3 Small reset travel—High crane lifts are possible with the No. 20 because the amount of travel between "run" and "tripped" positions has been kept at a minimum.

4 High interrupting capacity — Two normally open and two normally closed contacts, mechanically interlocked and with wide, vertical opening, always assure positive interruption of the hoist motor current.



No. 20 Youngstown size; 100 H.P.; 230 volts; single motor rating. Also available in duplex style.

This No. 20 Youngstown Limit Stop can be easily installed on new or old cranes, either alternating or direct current operated.

ASK FOR

NEW BULLETIN

1032

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79th STREET • CLEVELAND 4, OHIO

charge of development of engineering and construction projects in the Western Hemisphere and for clients in Europe.

•

F. G. Schmidt Assumes New Duties with Elpeco

Electric Power Equipment Corp., Philadelphia, has announced that Frederick G. Schmidt, who served as lieutenant commander in the Navy during the war, has been made chief engineer of its switchgear division.

F. G. Schmidt

Mr. Schmidt, who was formerly associated with the General Electric Co., succeeds W. R. Huttinger, for many years vice-president in charge of engineering. Mr. Huttinger is still associated with the company as a consultant.

With the termination of the war, the company began a modernization program in its switchgear plant, and also began production of commercial refrigeration products in its South Philadelphia plant.

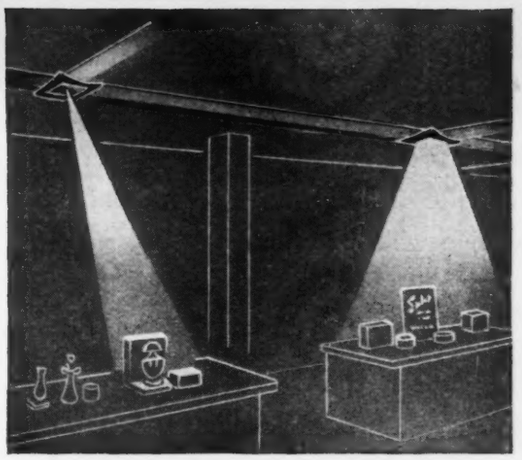
•

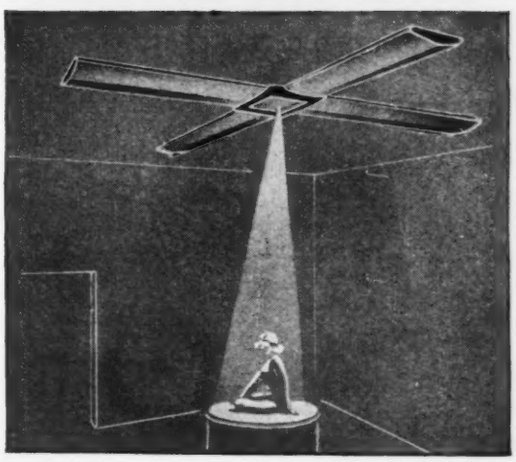
▶ Dr. Sanford A. Moss, consulting engineer of General Electric Co., will be awarded on April 17 the Potts medal of the Franklin Institute for his research on the aeronautic turbo-supercharger.

▶ Morell Mackenzie, vice-president of Claude Neon Lights, Inc., has been elected president and treasurer of Reeves-Ely Laboratories, Inc., 98 percent of whose outstanding common stock was recently acquired by Claude Neon Lights.

▶ Clyde E. Allen has been appointed sales manager for the entire Pacific Coast area of the Tru-Ad division of the Mitchell Manufacturing Co. Mr. Allen is a veteran sales and merchandising executive in the electrical industry, having served in important managerial positions with Graybar Electric Co., Edison General Electric Appliance Co. and the Electric Kitchen Appliance Co., all of San Fran-

This New HOLOFLUX *and* MODELITE *Combination Teams Up Fluorescent with Incandescent for Special-Purpose* STORE LIGHTING





This HOLOFLUX unit has been especially designed for store lighting, providing versatile combinations of fluorescent and incandescent illumination. Two types of incandescent inserts are available which deliver:

(1) A narrow, directable beam for intensifying feature displays.

(2) A strong flood of warm illumination to provide relief from the monotony of undiluted fluorescent lighting.

These component parts fuse into an attractive, smooth flowing design architecturally suitable to any interior treatment of the modern store.

Write for Data. Consult Holophane Engineers, no obligation.

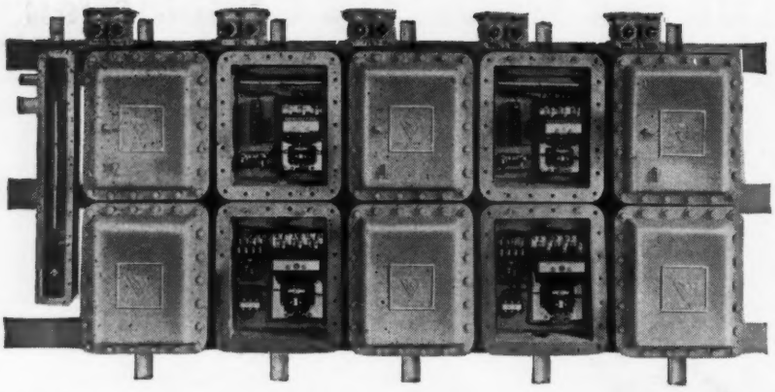
VISIT THE HOLOPHANE BOOTH NO. 26

International Lighting Exposition
Hotel Stevens, Chicago
April 25th to 30th

Holophane

HOLOPHANE COMPANY, INC.... *Lighting Authorities Since 1898*

342 MADISON AVENUE, NEW YORK 17 • Holophane Co., Ltd., 385 Yonge St., Toronto, Can.



EXPLOSION PROOF CONTROL PANEL FOR FIVE GROUPS OF ELECTRICAL STRIP HEATERS INSTALLED ON ETHYLENE GAS PIPE LINES & DRUMS. THE PANEL MADE UP OF FIVE SECTIONS & EACH SECTION CONTROLS SEPARATELY ONE GROUP OF HEATERS. A MOTOR OPERATED SEQUENCE SWITCH & TEMPERATURE INSTRUMENTS (NOT SHOWN) OPERATES THE VARIOUS CONTACTORS & RELAYS SO THAT THE HEATERS ARE CONNECTED IN PARALLEL OR IN SERIES DEPENDING ON THE TEMPERATURE REQUIREMENTS.

R&S CUSTOM BUILT PANELS

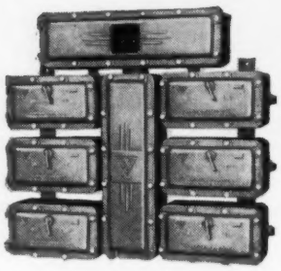
FOR ALL HAZARDOUS AREAS

Over the years R&S has pioneered in the development and standardization of precision-built control equipment in keeping with industries' expanding requirements of new processes and codes.

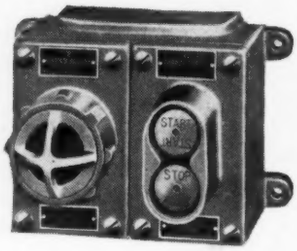
A large variety of standardized explosion-proof enclosures is available for grouping and assembly of control and power units in panel form, at minimum cost and without the usual delay of special designs.

R&S Standard Enclosures have wall sections permitting a great variety of conduit arrangements and sizes to suit job requirements. This simplifies material lists and reduces inventories caused by field changes.

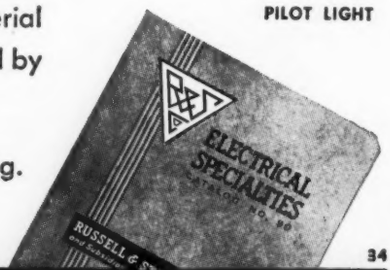
Ask for the 300-page R&S Catalog.



CIRCUIT BREAKER PANEL FOR LIGHT OR POWER



PUSH BUTTON STATION WITH PILOT LIGHT



Since 1902

Please address Dept. No. B

34

RUSSELL & STOLL COMPANY

EXPLOSION-PROOF, WATER-TIGHT, INDUSTRIAL LIGHTING FIXTURES AND EQUIPMENT. AUTOMATIC LOCKING "EVER-LOK" CONNECTORS

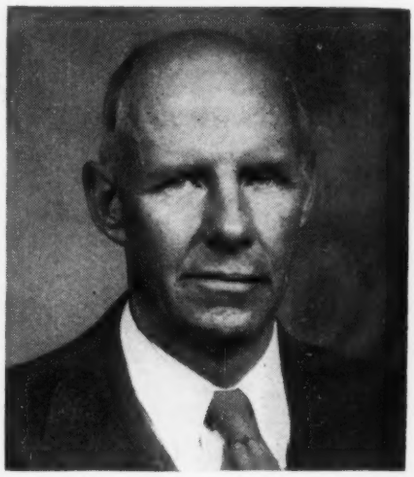
125 BARCLAY STREET · NEW YORK 7, N. Y.

cisco. He was born and educated in California and has spent his entire business career on the Pacific Coast. He is past-president and director of the San Francisco Electric Club, director of the Northern California Electric Bureau and active in the Pacific Coast Electrical Association.

•

W. J. Mann, Jr., New President of Wolfe & Mann Co.

William J. Mann, Jr., who recently was elected president of the Wolfe & Mann Mfg. Co., Baltimore, Md., together with the late E. L. Wolfe, founded the business in 1922. Mr. Wolfe became president and Mr. Mann, in the capacity of vice-president, acted as general manager in charge of engineering and works management, in addition to special engineering sales work. An electrical engineer, Mr. Mann was graduated from the University of Virginia in 1910.



W. J. Mann, Jr.

S. K. Bodine, who was made general manager and secretary of the company under the new executive set-up, started with the company in 1925 in the shop. In 1932 he was shifted to the sales department, working there as sales engineer until the late thirties, assuming in 1937 the duties of secretary.

H. T. Fee, vice-president, began with the company as a draftsman in 1927. He was transferred to the sales department, where he served as a sales engineer until the late thirties. In 1937 he was made treasurer.

Charles W. Walter, new plant superintendent, has been with the company since 1926. W. B. Mann, who was made treasurer under the reorganization, is an electrical engineering graduate of Johns Hopkins University.

•

► Lt. Col. C. G. Duy, Jr., has joined Proctor Electric Co., Philadelphia, as advertising and sales promotion manager.

RUBBER PLANTATION — AMERICAN STYLE

The only three butyl rubber plants in existence . . . those at Baton Rouge, Louisiana; Baytown, Texas; and Sarnia, Ontario . . . were engineered and built by Stone & Webster Engineering Corporation. In view of the many specialists required for each plant's design, erection and ultimate operation, we also acted as the coordinating agency.

Pictured above, unit #2, butyl rubber plant, Baton Rouge, Louisiana, operated by Standard Oil of New Jersey (Louisiana Division). Largest and first to go into operation; design capacity is 33,000 long tons of butyl rubber per year.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

A NEW COMPLETE LINE of All-Bright FLUORESCENT FIXTURES built to meet every lighting need

Designed and engineered for every lighting purpose in store, office, factory or drafting room. Custom-built. Available with "Instant-Start." No starters required. Lights with the flick of a switch. Individual or continuous rows.

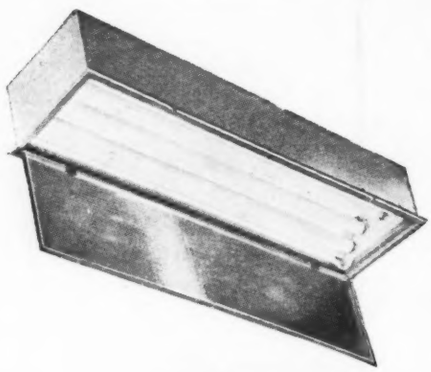
● Easily Accessible for Installation and Maintenance ● More Foot Candles

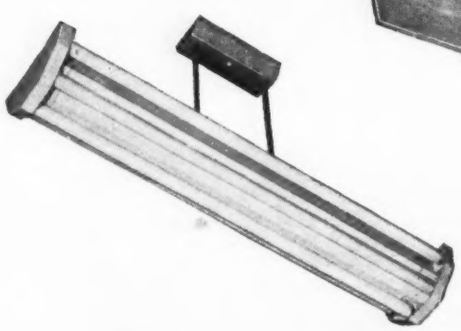
SKYLIGHT

Provides more foot candles . . . high intensity illumination with minimum glare. Choice of egg-crate or honey-combed louvers, or skytex ribbed glass.

RECESSED

Features a flexible frame that fits snug to the most uneven ceilings. Available in translucent skytex ribbed glass or metal louvers . . . "quick slide" catches for easy maintenance.



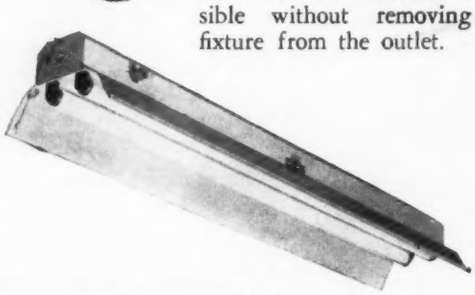


COMMERCIAL

An "all-purpose" lighting fixture designed to give greater light output at lowest possible cost. Ballasts and starters are accessible without removing fixture from the outlet.

INDUSTRIAL

Engineered for continuous "service - free" operation. Furnished with screw eyes for "easy level" chain hanging. Designed for chain, stem or surface mounting.



Send for new descriptive catalogs showing many more styles available.

Union Made—I.B.E.W.

ALL-BRIGHT ELECTRIC PRODUCTS COMPANY

Manufacturers of Fluorescent Lighting Fixtures

3917-25 N. KEDZIE AVE. CHICAGO 18, ILLINOIS

Mr. Duy goes to Proctor with a record of more than 14 years of utility and appliance sales, advertising and promotional experience. Prior to entering the Armed Forces, he spent six years at Westinghouse Electric Corp. and previously he had been connected with the Pennsylvania Power & Light Co. for eight years.

▶ A. A. MOLINE has been appointed chief engineer of Canadian Westinghouse Co., Ltd. Following graduation from the University of Colorado, Mr. Moline joined Westinghouse Electric Corp. as a graduate student, taking works management and mechanical design, with recognition by the University of Pittsburgh in the field of post-graduate study. He completed eleven years in the Westinghouse power engineering department and later became manufacturing engineer. Joining Canadian Westinghouse in 1937 as mechanical engineer, he engaged in the mechanical design of the company's heavy apparatus lines. Organizing the mechanical division during the war, he contributed much to Westinghouse materials conservation program. Mr. Moline is a member of the American Society of Mechanical Engineers, American Society for Testing Materials and the American Society of Metals.

▶ JOHN M. CAGE has been appointed manager of the industrial electronics division of Raytheon Mfg. Co., Waltham, Mass. Mr. Cage worked eight years in the research laboratory and vacuum tube engineering department of General Electric Co., taught four years at the University of Colorado and in 1943 joined the Allis-Chalmers Mfg. Co. to organize an industrial electronics group, remaining with that company until his recent appointment. IRVING C. BROWN has been appointed sales manager of the Raytheon industrial electronics division. Before joining Raytheon, Mr. Brown was sales manager of Thomson-Gibb Electric Welding Co., Lynn, Mass.

▶ BURTON R. COLE, formerly manager of the lamp, lighting and supply departments for Graybar Electric Co., Inc., in Seattle, has taken over the duties of communications sales manager for the company at its executive headquarters in New York City. During three years of the war, Mr. Cole, a graduate in electrical engineering of Leland Stanford University, served on a tour of duty with the United States Army Signal Corps, as a result of varied previous experience as a radio technician, U. S. Shipping Board radio operator, and as a radio installation engineer.

▶ WILLIAM E. BRADLEY, who played a leading part in developing the Philco FM system, has been appointed director of research of the Philco Corp. He suc-

HOW FAST
can you kill a substation fire?

Quick-Reading Facts About Kidde Total Flooding Systems

Q. *How does Total Flooding extinguish a fire?*

A. It fills the entire room, from floor to ceiling, with carbon dioxide, diluting the atmosphere to the point of oxygen-starvation for fire.

Q. *Can two or more fire-hazard areas be protected from one bank of cylinders?*

A. Yes; by means of directional valves (automatic or manual) carbon dioxide from one cylinder bank can be discharged into two or more areas.

Q. *Must protected areas be tightly closed?*

A. No. Kidde systems provide enough carbon dioxide capacity to allow for leakage around doors and windows. Systems can be designed for automatic closing of doors and windows, or to screen the area with a gas blanket, if no closure is present.

CAN you do it in 20 seconds or less—even in an *unattended* substation?

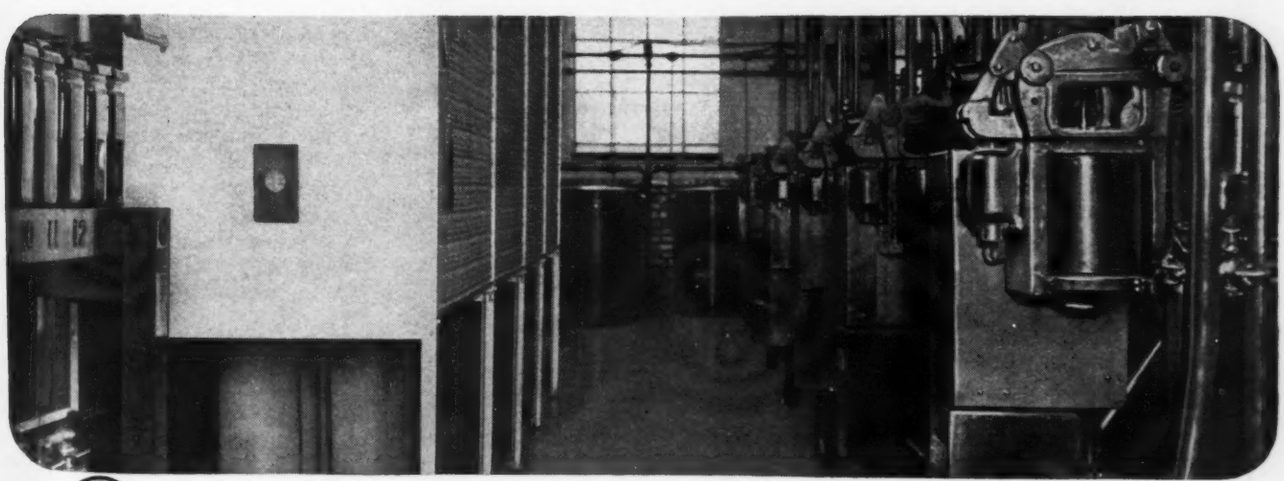
You can if the substation's protected by a Kidde Total Flooding System!

When arranged for *automatic* operation, a Kidde system goes into action almost as soon as a fire starts. Immediately, carbon dioxide pours into the entire enclosed area. The gas swirls around obstructions . . . penetrates into windings and through complex wiring . . . smothers flames wherever they are.

There's no damage to insulation, no corrosion of metal, no danger of flashover between adjacent parts. No after-fire mess to clean up.

Kidde systems can be arranged for *manual* operation too, if better suited to your particular requirements. A Kidde representative will be glad to discuss with you the choice of automatic or manual types.

Walter Kidde & Company, Inc.
430 Main Street • Belleville 9, New Jersey



K Kidde

The word "Kidde" and the Kidde seal are trade-marks of Walter Kidde & Company, Inc.

Kidde

5 STEPS TO SAFETY
SELF-CLEANING, no sharp corners to clog.
EASY TO MAINTAIN . . . paint reaches entire surface.
MAXIMUM OPEN AREA for light and air.
SAFE footing at all times with twisted cross bar.
STRONG electroforged construction for easy erection.
SAFE, because the twisted bar reduces slipping . . . and STRONG, because it's electroforged into one solid piece. Whatever your grating needs, you can depend on Blaw-Knox.
When further improvement for open-steel floors is called for by changes in business practice—Blaw-Knox will lead as always.
Blaw-Knox Catalog No. 1887 gives complete details on Blaw-Knox Electroforged Steel Grating. Send for it.
BLAW-KNOX GRATING
Seven Blaw-Knox plants have been awarded the Army-Navy "E", and have regularly received renewal stars for continued high achievement in the production of war material.
Division of Blaw-Knox Company
2013 Farmers Bank Building
Pittsburgh 22, Penna.

ceeds David B. Smith, now vice-president in charge of engineering. Mr. Bradley joined Philco in 1936 and five years ago was placed in charge of the advanced research section of the research division, in 1945 becoming assistant director of that division. Mr. Bradley has to his credit numerous patents and patent applications in the field of FM radio, television and radar.

OBITUARY

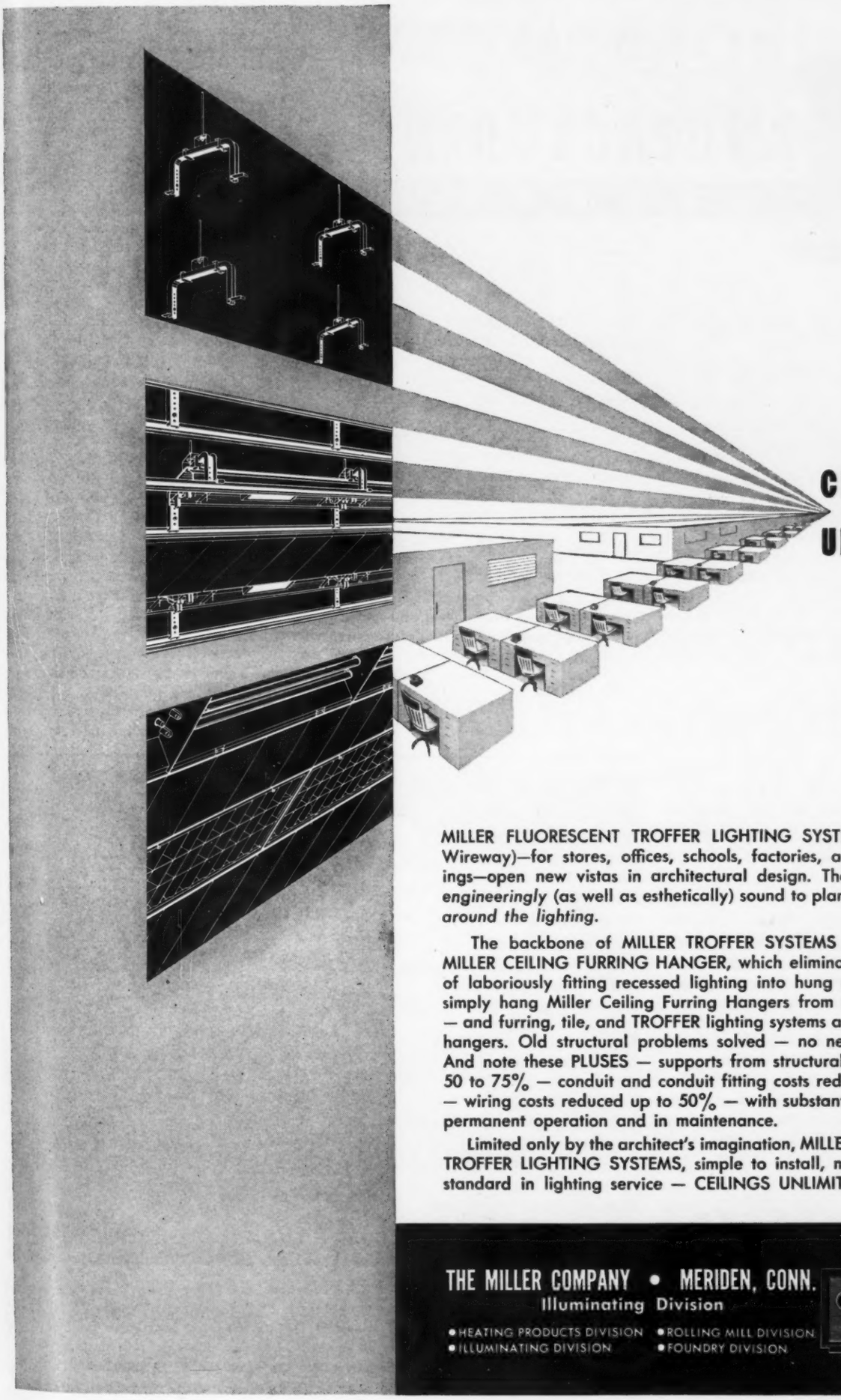
▶ EDGAR E. CRABTREE, 76, who was local manager for the Illinois Power Co., at Jacksonville, Ill., from 1939 until he retired a few months ago, died on March 31 after an extended illness. Mr. Crabtree was elected mayor of Jacksonville in 1919 on a platform of "no pay, no politics" and served for eight years at a dollar a year. He was in the banking business in Jacksonville for more than 30 years.

▶ HARRY L. THOMSON, 59, for many years meter and appliance engineer of the Hartford (Conn.) Electric Light Co., died in that city on March 24. He joined the company in 1910, became superintendent of the lighting department in 1918, and attained his late post in 1933. He was active on technical committees of the Edison Electric Institute and Association of Edison Illuminating Companies, and has devoted much time in late years to research in the appliance development and load building fields.

▶ CLYDE R. PLACE, consulting engineer, died in New York on March 28 in his sixty-ninth year. A graduate of the Massachusetts Institute of Technology, Mr. Place had practiced in New York since 1914 and was a specialist in engineering design. He planned the electrical, mechanical, air conditioning, power and elevator systems for many famous buildings.

▶ H. A. STEPHENS, local manager of the Southwestern Gas & Electric Co.'s office at Greggton, Tex., died on February 6 as the result of a heart attack. Mr. Stephens, who was 55 years of age at the time of his death, was owner of the Greggton electric system before it was acquired by Southwestern about two years ago. He was born in Ontario, Canada, and came to the United States when a young man.

▶ WILLIAM J. FITZGERALD, for 23 years manager of the Monroe, Mich., district for the Detroit Edison Co., died of heart disease on March 26 in Monroe. Mr. Fitzgerald was 65 years of age. He had been with the Detroit Edison Co. since 1910, starting in Plymouth. He removed to Monroe in 1920, and retired last September.



CEILINGS UNLIMITED

MILLER FLUORESCENT TROFFER LIGHTING SYSTEMS (continuous Wireway)—for stores, offices, schools, factories, and public buildings—open new vistas in architectural design. Their use makes it *engineeringly* (as well as esthetically) sound to plan entire buildings *around the lighting*.

The backbone of MILLER TROFFER SYSTEMS is the patented MILLER CEILING FURRING HANGER, which eliminates the necessity of laboriously fitting recessed lighting into hung ceilings. Instead, simply hang Miller Ceiling Furring Hangers from structural ceiling — and furring, tile, and TROFFER lighting systems are hung from the hangers. Old structural problems solved — no new ones created. And note these PLUSES — supports from structural ceiling reduced 50 to 75% — conduit and conduit fitting costs reduced up to 80% — wiring costs reduced up to 50% — with substantial economies in permanent operation and in maintenance.

Limited only by the architect's imagination, MILLER FLUORESCENT TROFFER LIGHTING SYSTEMS, simple to install, mark a new high standard in lighting service — CEILINGS UNLIMITED.

THE MILLER COMPANY • MERIDEN, CONN.
Illuminating Division

• HEATING PRODUCTS DIVISION • ROLLING MILL DIVISION
• ILLUMINATING DIVISION • FOUNDRY DIVISION

MILLER SINCE 1844

MANUFACTURING MARKETS

Germans to Lose Half of Electrical Industry

Manufacturing Equipment to Go to Allied Nations for Reparations—Output Limited to 9,000,000 Kw.

The German electrical manufacturing industry, which once powered much of Europe and a substantial portion of the world other than the United States and Great Britain, is to be cut to half or less of its 1938 production capacity under an Allied Control Council decision made under the authority of the Potsdam Declaration. Manufacturing equipment in excess of the permitted levels is to be made available to nations claiming reparations from Germany under the terms of the Potsdam Declaration.

The recent Allied Control Commission determination of the allowable levels of various industries in post-war Germany hewed most closely to the line proposed by the United States, lowering what the British had proposed to be left and generally raising what the Russians wanted to leave.

Of Germany's heavy power equipment industry, manufacturing such items as boilers, prime movers, turbines and converters of more than 6,000-kw. capacity, high-voltage switchgear and transformers of more than 1,500-kva. capacity, 30 percent of the 1938 production capacity (40,000,000 reichsmarks worth of 1936 values) may be retained. The remainder is to be available for reparations.

Of what is described as the German "electro-engineering" capacity, manufacturing lamps, fittings, small appliances, wire and cable and similar equipment, 50 percent of the 1938 capacity is retainable.

Germany will be permitted to retain 9,000,000 kw. of its power-generating capacity, the figure which the United States subcommittee, headed by Director Edward Falck of the Office of War Utilities, had recommended. War-time capacity in Germany was about 22,000,000 kw. No figures of what power capacity the Russians wanted to leave have been made available. The British proposed leaving about 14,000,000 kw. The difference between 22,000,000 kw. and the allowable 9,000,000 kw., minus plants damaged by bombing and some industrial power installations lost in the destruction of direct munitions plants, will be available for reparations.

The recent Allied Control Commission determination failed to stipulate the power plants which are to be removed.

•

Leland Resumes Work

Leland Electric Co., Dayton, Ohio, after a 60-day shutdown caused by shortages of materials due to the steel and copper strikes, has resumed operations. The first shipment of completed motors is scheduled for April 24. The company has an order backlog sufficient to keep the plant in production until the beginning of the second quarter next year.

"Relighting America," A Big Job: Bishop

By combining its engineering genius with smart promotion and selling, the electrical industry can relight the entire country within the next ten years, according to Robert H. Bishop, general sales manager of Sylvania Electric Products Inc., who recently addressed a group of industry executives in Portland, Ore.

Speaking on the subject, "Lighting in the Future," Mr. Bishop discussed his company's comparatively new policy of conducting surveys to determine the market for lighting and lighting products, then manufacturing products for sale to that market.

"We've got a big job ahead of us," he declared, "because the market for modern lighting is tremendous. There are 38,000,000 families in this country and each of them is a potential user of fluorescent lighting, yet there are only four-and-a-half million commercial electric meters in the United States and approximately 150,000 industrial meters.

"To sell lighting products to this market however, the lighting salesman must be a combined engineer, lighting salesman and merchandising man. He must be part architect, part designer and part display man. He must know all about color and the effects it creates because color is now an important part of light-

HOME TO FLUORESCENT—Convalescent veterans from Camp Upton, N. Y., members of the home planning class of the Army Service Forces' rehabilitation educational program, listen to Kathleen Hanway, Sylvania Electric Products, Inc., home lighting consultant, explain the use of fluorescent in home lighting. The group consists of Corp. Funaro, instructor and architect, and Pvts. William Westland, F. H. Rourke and Donald Richardson, who plan to build and remodel homes after being mustered out

in your Motors and Generators

Ever stop to think how important electric generators and motors have become to "our" World? Practically every convenience we enjoy . . . the effectiveness of our War Effort . . . the assurance of a fully employed postwar World . . . depend on electric generators and motors.

C-D MICABOND . . . mica electrical insulation . . . helps keep these generators and motors running.

Generator and Motor manufacturers specify C-D MICABOND because it provides them with the "perfect insulation"—MICA—in usable forms. C-D MICABOND sheets, tubes, rings, segments and other shapes are provided by bonding mica splittings with insulating resins. For complete technical and mechanical data send for Bulletin "M".

KX-45

C-D PRODUCTS

The Plastics

DILECTO—A Laminated Phenolic.

CELORON—A Molded Phenolic.

DILECTENE—A Pure Resin Plastic Especially Suited to U-H-F Insulation.

HAVEG—Plastic Chemical Equipment, Pipe, Valves and Fittings.

The NON-Metallics

DIAMOND Vulcanized FIBRE

VULCOID—Resin Impregnated Vulcanized Fibre.

MICABOND—Built-Up Mica Electrical Insulation.

Standard and Special Forms

Available in Standard Sheets, Rods and Tubes; and Parts Fabricated, Formed or Molded to Specifications.

Descriptive Literature

Bulletin GF gives Comprehensive Data on all C-D Products. Individual Catalogs are also Available.

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WEST COAST REPRESENTATIVES
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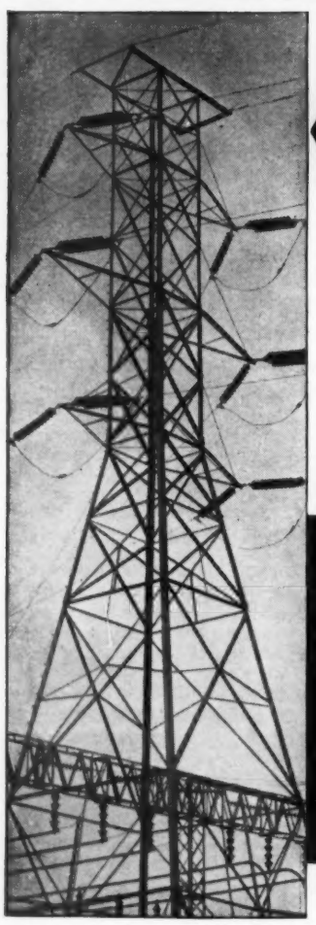
Established 1895 . . Manufacturers of Laminated Plastics since 1911—NEWARK 15 • DELAWARE

CIRCULAR CONSTRUCTION GIVES EXTRA STRENGTH!
BLACKBURN Service Entrance CONNECTORS
YES, the circular construction of BLACKBURN Service Entrance CONNECTORS gives extra strength along the line of pull of the screw. These connectors will not stretch or distort when tightened—will not come loose.
What's more, BLACKBURN CONNECTORS are inherently strong, because they are made of DURONZE. This high-strength silicon bronze is 75% stronger than hard-drawn copper, commonly used in other connectors.
In short, BLACKBURN CONNECTORS are the strongest and most durable connectors made—hence, a real economy!
Over 100 Conveniently-located Jobbers' Stocks
JASPER BLACKBURN PRODUCTS CORP.
Main, Clinton & Madison Sts., St. Louis 6, Mo.
Builders of Quality Connectors for Over 10 Years



DILLON DYNAMOMETER

A multitude of Dillon Dynamometers are protecting communities and companies alike from failures caused by wires going down in severe storms. Standard for dependable accuracy, simplicity and convenience. Actual size 8¼" x 6¼" x 3". In wide use also in telephone and telegraph work for indication of tension in guy strands, messenger and wire. Many other uses where torque, weight, and overload are vital factors. Take out guesswork of "sight and sag". Hooked on in a jiffy, indicates tensions in seconds. Direct reading. Nine capacities, 500 to 20,000 lbs. There's a place for the Dillon in every Electrical Plant.

Send for illustrated Dynamometer Manual.

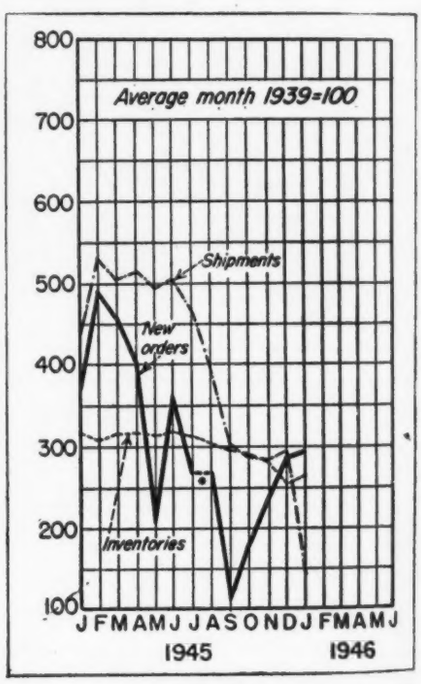
W. C. Dillon & Co., Inc.
5423 W. HARRISON ST. CHICAGO 44, ILL.

ing, and he must have a working knowledge of fabrics and their possibilities. Moreover, he must be able to adapt all this knowledge to each and every field in which he is attempting to sell because today the lighting salesman is selling more than just lamps and fixtures. He is selling good lighting which involves many other factors as well."

•

New Orders Move Upward in January

New orders placed with the electrical machinery industry in January, 1946, advanced slightly over December, 1945, according to figures released by the Bureau of Foreign and Domestic Commerce. The index compiled by the Bureau moved upward to 294 from 287 (revised) in December, 1945, and compares with 371 in January, 1945.



ELECTRICAL MACHINERY INDICES of Bureau of Foreign and Domestic Commerce. *August orders not plotted. Cancellations exceeded orders.

Following the general trend, shipments of electrical machinery in January dropped sharply—145 in January, 1946, compared with 296 (revised) in December, 1945.

Electrical machinery industries recorded inventory increases, the index compiled by the Bureau advancing to 264.0 in January from 250.5 (revised) in December, 1945.

•

Armstrong Makes FM Pact

Maj. Edwin H. Armstrong has announced that he had granted a license

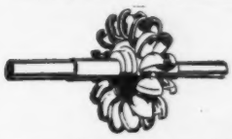
for Peak Output with Varying Heads

BALDWIN KAPLAN-TYPE TURBINES

The important thing to remember about Baldwin Hydraulic Turbines is that there is a type and size to meet every normal need.

Just to illustrate—in developments where there is a wide seasonable variation in river flow . . . or where flood conditions may cause tail water to rise and so cause fluctuations in head . . . or where draw-downs cause a similar change . . . or where the hydro-plant is used to establish and control system frequency, the Baldwin Kaplan-Type Turbine is the ideal unit to install.

Five Baldwin Kaplan-Type Turbines with runners 22 feet in diameter are installed at Chicamaugua Dam of the T.V.A. System. These are only a few of many. Our engineers will be glad to confer with you, and recommend the type and size of Baldwin turbine that will best serve your needs.



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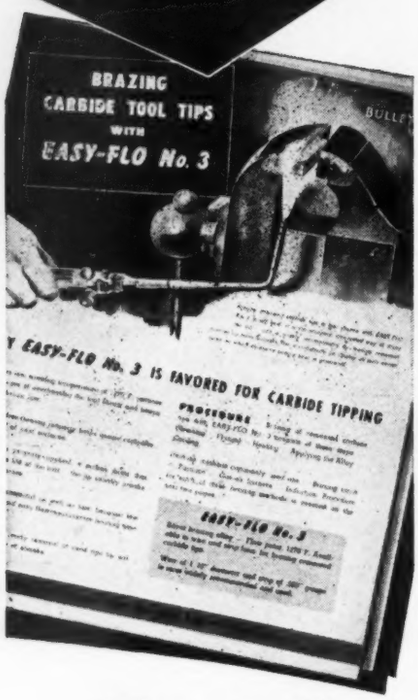
The PELTON WATER WHEEL CO., SAN FRANCISCO

THIS BULLETIN TELLS YOU HOW TO DO IT.



The method recommended by leading carbide tip manufacturers

The bulletin explains why brazing carbide tips to tool shanks with EASY-FLO No. 3 is fast, reliable and economical.

It tells you how to do the job step by step with each step illustrated. You'll find it easy to follow.

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to Western Electric Co. under his frequency modulation patents for the manufacture and use of FM apparatus for mobile and other communication purposes.

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Manufacturers Issue Earnings Reports

Among the electrical manufacturing companies recently issuing reports on earnings are the following:

GENERAL CABLE—Net income for 1945 totaled $2,569,543 after all charges, including $8,100,000 provision for taxes, but exclusive of $859,962 profit on sales of securities. This compares with 1944 net income of $2,855,572 after $11,800,000 provision for taxes, but including credit of $227,503 from renegotiation and $423,520 tax and renegotiation refunds due to accelerated amortization. As a result of adjustments of amortization of emergency war facilities, 1945 profits were increased by approximately $310,000, and, in addition, earned surplus was credited with $825,614, covering claims against the Government for tax and renegotiation refunds attributable to acceleration of amortization deductions for earlier years.

JOHNS-MANVILLE—For 1945, net income reported tentatively at $5,099,173, equal to $5.72 a common share, compared with $5,476,213, or $6.39 a share in 1944; sales, $85,989,368, against $101,211,499. Company stated strikes had deferred preparation of final audited statements.

MALLORY, P. R. & Co.—For 1945, net profit, $978,664, equal to $2.42 each on 402,942 common shares on sales of $47,198,145. This profit is before renegotiation and compares with $930,432, or $2.70 each on 343,620 common shares after renegotiation on sales of $41,483,485 in 1944.

Show Color in Light Visualizer at Exhibit

A color in light visualizer, which graphically portrays the different effects created in a single room by incandescent and three kinds of white fluorescent lamps, was shown recently by Sylvania Electric Products Inc., at the Essex Electrical League's Industrial Exhibition in Newark, N. J.

Architects, electrical engineers, contractors, jobbers and distributors viewed the color visualizer, which clearly shows how the color of the light source affects the colors of walls, ceiling, draperies, rugs and furniture coverings used in a room. Incandescent, fluorescent daylight, 4,500-deg. white and soft white lamps are employed in the four theater-like compartments of the box, and the contrast between the differently lighted sections offers visible proof that care must be taken in selecting the correct type of illumination for each color scheme to achieve full and true colors in home interiors.

The room lighted by an incandescent bulb appeared to have an amber cast with the yellow colors standing out prominently. Daylight fluorescent gave a blue tone to the same room and made it look cold and austere. A more desirable effect was achieved by the soft white fluorescent lamp which brought out the reds in the interior and gave a warm feeling to the room. The new 4,500-deg. white fluorescent, warmer than daylight but clearer and cooler than standard white fluorescent, made the

INVENTORS HONORED—While employees of the engineering department looked on, three veteran inventors of Landers, Frary & Clark, (left to right) Paul Kircher, Fred Juengst and Oscar Anderson, were presented with awards recently by W. J. Russell, vice-president in charge of engineering, for devising and patenting outstanding improvements in company's products. The patent award system was instituted last June by the company as one means of recognizing the ability of inventors

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Standard Sprague Koolohm Wire Wound Resistors have the high insulation resistance to ground which you need for television and other applications where high voltages are involved—*10,000 volts from the surface of their sturdy ceramic jackets to their resistance elements.* Mount them anywhere without fear of voltage breakdown!

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The Greatest Wire-Wound Resistor Development in 20 Years

This is the season
for **GROUND TESTING**
Wet, or Dry

Testing of resistance to earth, of man-made grounds under all conditions, is done more *accurately*, more *easily*, more *speedily* with the VIBROGROUND.

VIBROGROUND

Ground Resistance Tester

Sturdy, compact, dependable. Easily portable. Precision engineered throughout. No calculations. No reverse readings, nor polarization errors. All AC and DC strays excluded. New Model 255, illustrated, for extremes of wet or dry conditions. Four ranges, 0-3, 0-30, 0-300, 0-3000 ohms. Model 251 for average conditions, has 3 ranges.

Model 255

NO CRANKING

Like all **Associated Research** products Vibroground is *thoroughly modernized*. Has most dependable self-contained power source. No tiresome cranking. Just press button balance galvanometer, and read directly at potentiometer pointer.

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Also mfrs. of Vibrotests insulation resistance testers, full line of testing instruments, Keeler Polygraph (lie detector), etc. Engineering service representatives in all principal cities.

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"ADVANCE" BALLASTS EXCEL IN QUIET OPERATION, high efficiency performance, low replacement cost and long life. They permit easy installation in fixtures where only a limited space is allowed for ballasts. Designed by expert lighting engineers and approved by Underwriters Laboratories, "Advance" ballasts are the answer to all fluorescent lighting problems. LARGE MANUFACTURERS OF LIGHTING FIXTURES STANDARDIZE ON "ADVANCE" BALLASTS—so insist on this quality ballast on the equipment YOU buy.

ADVANCE TRANSFORMER COMPANY
1108 W. Catalpa Ave. **Chicago 40, Ill.**

colors remain constant and approximated the fresh effect achieved by true daylight.

Another feature of the display is a lamp panel showing the entire assortment of incandescent and fluorescent lamps which are now available for homes being built under President Truman's projected housing plan.

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Manufacturers Make Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

W. N. MATTHEWS CORP., St. Louis, has appointed Shaw Hardy as its sales agency in Florida. Mr. Hardy has been connected with the electrical industry for the past 25 years, the past nine years in Florida as a manufacturers' representative.

DUNCAN ELECTRIC MFG. CO., Lafayette, Ind., has named Ernest E. Hewitt manager for the Middle West territory with offices at 537 S. Dearborn St., Chicago. Mr. Hewitt joined the Duncan company in 1933.

ACME ELECTRIC & MANUFACTURING CO. has appointed A. J. Weilbaecher of 303-A Levert Building, 823 Perdido St., New Orleans, as sales representative in Louisiana, Mississippi and western Tennessee.

ALLIS-CHALMERS MFG. CO. has named R. H. Porterfield manager of a new branch office in the New England district located at 1607 Industrial Trust Bldg., Providence, R. I. Mr. Porterfield has been with Allis-Chalmers since 1939.

•

Washer, Irons Price Rise

Manufacturers of washing machines and electric irons have been given an additional 1.8 percent price increase, but the Office of Price Administration said retail prices will not be affected. These manufacturers previously were granted an increase of 7.7 percent over pre-war prices, although March, 1942, retail prices were not changed by that adjustment either. Distributors are required to absorb both increases. The additional 1.8 percent increase is being granted, OPA said, to reflect labor cost increases which were not taken into account when prices were fixed last fall.

•

Forms Canadian Company

In order to serve its Canadian customers better, Control Corp. of Minneapolis, Minn., has organized the Control Corp. of Canada, Ltd., with headquarters at 40 Lightbourne Ave., Toronto. In addition to handling all Canadian sales, the new company will maintain a staff of engineers experienced in custom fitting supervisory control and telemetering to power systems.

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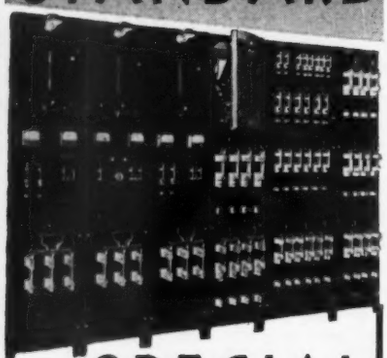
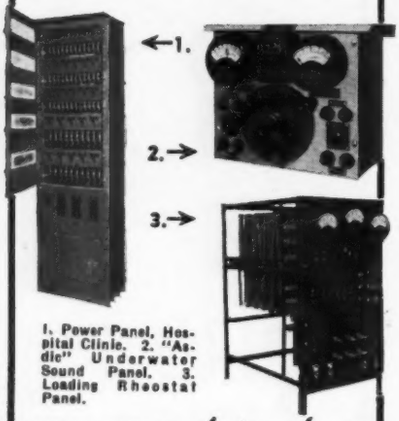


or SPECIAL



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UNEXCELLED QUALITY

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Field Reports on Business

Shortage of materials for the production of electrical equipment is slowing down plant output, but new planning for industrial expansion goes on. Machinery orders are being accepted on long-term deliveries. A few heaters, radios, and irons appear, but no large lots are available.

NEW ENGLAND

Lack of raw materials for the production of electrical equipment is slowing down plant output and causing a good deal of uneasiness in the electrical market. At the Pittsfield works of General Electric the return of veterans and scarcity of materials have caused layoffs; moreover, it is expected that much of the construction program that has been planned probably will suffer serious delay because of the federal allocation of building materials exclusively to housing projects.

Meanwhile new planning in this district for industrial expansion goes on. Sprague Electric Co., North Adams, has 162 radio and electronic engineering projects under way and the shift from war to civilian production, when once in full swing, will mean that even more will be started. Manufacturers are reported to be seeking more than 7,000,000 sq. ft. of floor space in Connecticut for plant operations.

Interest in infrared drying applications is very strong and many inquiries are coming in with regard to enamel and paint coating processes. Commercial refrigeration is active; installation of six ½-hp., cold box units was recently completed for Hoods, Brookline, Mass. Modernization of small stores in greater Boston areas is flourishing: Fiske Candy Shop, Cambridge and Lord's, have installed new lighting fixtures. Hudson (Mass.) Municipal Lighting Department reports 30 electric ranges and 4 water-heaters added to its system last year, making a total of 755 ranges and 132 water-heaters in use.

A contract to build a $37,000 addition to the Braintree (Mass.) municipal electric light plant has been awarded to C. C. Temple, Boston. Plans call for the installation of a new boiler.

The appliance picture is a drab one; a few heaters, radios, and irons appear from time to time, but as yet no large lots are in the market.

PACIFIC COAST

Despite their installation of a strict allocation schedule and checking of pyramided orders, wholesalers report an ever-increasing backlog of orders which has been climbing far beyond the meager stock shipments so far received. Construction permits skyrocketed prior to the recent building curb regulation, their March value for San Francisco, for example, being six times that for the previous month.

Machinery orders are being accepted on long-term deliveries, intensified by recent and pending strikes of General Electric and Westinghouse respectively, so that even staple fractional and small integral motors are on a two-year delivery basis. A dairy machine manufacturer has ordered $40,000 of stock size motors: a food packing plant is installing three 270-kva. capacitors: the Key System Interurban Line has bought 25 sets of trolley coach electrical equipment, costing close to $100,000.

Fluorescent lamp ballasts are being bought by Coast fixture manufacturers in exceedingly large quantities, one such order totaling $400,000 and the total value of this comparatively new local source of business is said to run well over a million dollars.

Outstanding among all recent housing projects is the $25,000,000 subdivision planned for Pomona, in southern California, of which the first block of 500, costing $5,000,000, is scheduled for construction as soon as materials are available. It is noticeable that such homes average $10,000 each or over double the comparative pre-war figure, and the electrical industry is hoping that there may be a commensurate increase in the value of each electrical installation.

NEW YORK

In spite of the bituminous coal strike and other disputes still unsettled, the industrial outlook appears somewhat brighter. Price advances to cover, or partially cover, the added costs of wage increases have been made in some important areas.

A compilation of the net income of 2,806 leading corporations for 1945 and 1944 was issued recently by the National City Bank. The corporate earnings reports, according to the bank, show that aggregate net income for 1945 was 3.7 percent under 1944; that the rate of return on net worth declined and that the average profit per dollar of sales "continued around the low levels which have been the rule during the war years."

Civil Engineering construction volume in continental United States totaled $130,993,000 for the week ending April 4, 1946, as reported to *Engineering News-Record*. This volume is 3 percent below the previous week but 289 percent above the corresponding week of last year.

Sales of department stores in the Metropolitan area increased 54 percent last week over last year, the later date of Easter being an important factor in the large increase.

CHICAGO

The present force of electrical contract labor in Cook County is more than adequate to handle the proposed construction of 75,000 new dwelling units for veterans this year, particularly in view of plans for building of multiple-dwelling projects. These include a 12,000-unit structure announced by Prudential Life Insurance Co.

An intensive signing up of apprentice electrical labor is now in progress in the county, with a view to adding about 450 men, including 300 new men and 150 returning veterans. Most of the apprentices will be selected from among those now working on temporary permits. Training cost per man is estimated at about $675.

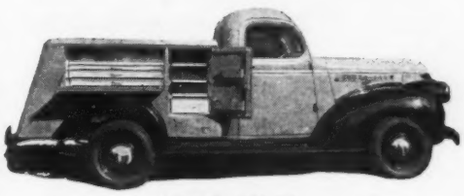
Commonwealth Edison Co. has 50 days' coal supply on hand and expects that it will therefore not be affected by the coal strike. This year's construction program of the company includes a 107,000-kw. unit at the Calumet station, additions to numerous utility plants, and improvements to the Edison and Marquette buildings.

Part of the proposed seven-year public works program recently announced by Mayor Kelly involves the expenditure of $8,000,000 for street lighting, $44,000,000 for new subways, and $45,000,000 for the new airport.

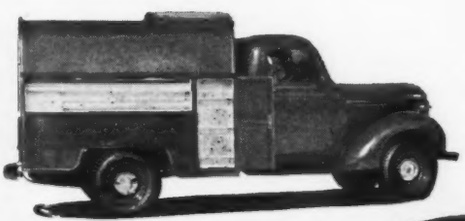
Sales of major household appliances by department stores in the 7th Federal Reserve District in February rose 325.8 percent over the same month of 1945, while stocks rose only 161.1 percent.

TOP PERFORMANCE

MODEL 4013-AL
Heavy service Unit with overhead ladder.



MODEL LIU-78
Light Service Body fully enclosed.



MODEL 4013-AT
Service body with telescoping roof.

MODEL 4013
Light service body open type.

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COMPACT . . . because all available loading space is profitably utilized.

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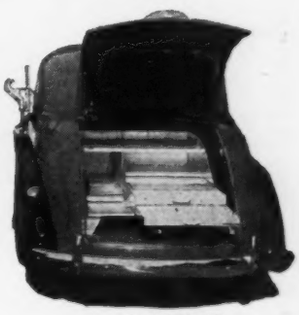
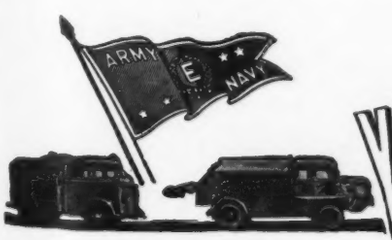


MODEL 39
Service Unit with ladder brackets.



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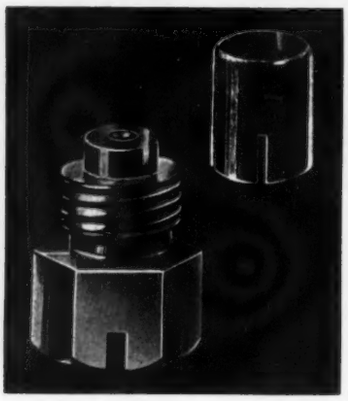

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Sales Opportunities

WASHINGTON—**Pacific Power & Light Co.**, Portland, Ore., plans extensions in hydroelectric generating station at Naches, with installation of equipment for increased capacity. Also will build new steel frame switchyard, with circuit breakers, automatic control apparatus and other switchgear installation. Entire project reported to cost about $200,000. Bids are scheduled to be asked at early date. John W. Maloney, Larson Building, Yakima, is architect and engineer.

TENNESSEE—Tennessee Products Corp., American National Bank Bldg., Nashville, insulation coal tar and wood distillation products, plans expansion in plant at Chattanooga, including several new one and multi-story buildings, with machinery and electrical equipment for large increased capacity. Cost reported over $1,500,000. Proposed to begin work at early date.

IOWA—State Board of Education, Des Moines, has authorized plans for expansion and improvements in power plant at Iowa State College, Ames, including complete remodeling and modernization of present station, construction of new addition and installation of equipment for considerable increased capacity. Cost estimated close to $900,000. Engineer will be selected soon to make surveys and prepare plans.

WYOMING—Bureau of Reclamation, Denver, Colo., will receive bids until April 29 (postponed from April 8) for construction of 34,500-volt transmission line from connection with Pilot Butte-Thermopolis high-tension line to construction substation at Boysen dam, and 2,400-volt distribution line from that point to Boysen government camp, and installation of a distribution system at latter place, Missouri Basin project, Boysen unit, Wyo. (Specifications 1200).

PENNSYLVANIA—Metropolitan Edison Co., Reading, has plans maturing for large addition to generating station at Middletown, with installation of equipment for considerable increased capacity. Contract for building erection will be awarded soon. Gilbert Associates, Inc., Reading, is consulting engineer.

NEW JERSEY—E. I. duPont deNemours & Co., Inc., duPont Bldg., Wilmington, Del., plans expansion in chemical works, including seed disinfectant plant at Carney's Point, including several new buildings, with installation of machinery and electrical equipment for increased output. Cost reported close to $1,000,000. Work is scheduled to be carried out at early date.

NORTH CAROLINA—City Council, New Bern, will receive bids until May 6 for extensions and improvements in municipal steam-electric generating plant, with installation of additional equipment. Burns & McDonnell Engineering Co., 107 West Linwood Blvd., Kansas City, Mo., is consulting engineer.

MONTANA—Bureau of Reclamation, Denver, Colo., will receive bids until April 23 for three 34,500-volt, single-pole, hook-operated, outdoor-type, expulsion fuse disconnecting switches; three additional similar switches; eight 5,000-volt insulated, single-phase, outdoor-type transformers; two two-element, three-phase, three-wire watt-hour indicating demand meters in weatherproof

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The heavy rubber changer head (left) removes dead lamps and replaces new lamps easily and surely. Reverse the changer head on the sectional pole and the unit becomes a broken base remover (right).

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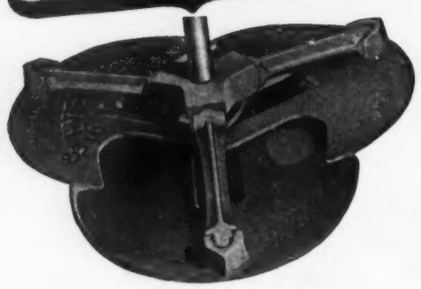

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EVERSTICK ANCHOR CO.
FAIRFIELD, IOWA

cases; and one single-pole outdoor-type lightning arrester, all for installation in present Frazer and Wiota power substations, Fort Peck project, Mont. Equipment will be installed by government.

MASSACHUSETTS—Propper-McCallom Hosiery Co., Inc., Florence, has plans nearing completion for new additions to local plant, comprising a large one-story mill unit and several smaller structures, with machinery and electrical equipment for heavy output. Cost close to $1,000,000. Erection contract will be awarded this spring. Lockwood, Greene Engineers, Inc., 10 Rockefeller Plaza, New York, N. Y., is engineer. Executive offices of company are at 200 Madison Ave., New York.

MISSOURI—Tri-County Electric Cooperative Association, Lancaster, has rejected bids recently received for extensions in primary and secondary lines in parts of Schuyler and Scotland counties, totaling about 130 miles, and will ask new bids in near future. Stanley Engineering Co., Muscatine, Iowa, is consulting engineer.

CALIFORNIA—Bureau of Reclamation, Denver, Colo., will receive bids until April 30 for one trashrack and trashrack hoist, for penstock intake trashracks. Kenwick dam, Kennett Division, Central Valley project, Calif. Equipment will be installed by government (Specifications 1258).

LOUISIANA—Sewerage and Water Board, 526 Carondelet Street, New Orleans, J. E. Morrill, secretary, will receive bids until April 30 for equipment for installation in waterworks power station, including three 4,000-hp. watertube boilers; coal pulverizers and burners; forced and induced draft fans and air pre-heaters, all as per plans and specifications on file.

NEW YORK—Eastman Kodak Co., Kodak Park, Rochester, plans extensions in power plant, with installation of equipment for considerable increased capacity. Contract for erection of new steel frame structure will be awarded soon.

NEW MEXICO—Bureau of Reclamation, Denver, Colo., will receive bids until May 1 (postponed from April 15) for transformers, reactors, switching equipment, metering equipment, relays and lightning arresters for Elephant Butte power plant, and power substations at Alamogordo, Hollywood and Socorro, Rio Grande project, New Mexico-Texas (Specifications 1198).

GEORGIA—Southern Paper Board Corp., recently organized subsidiary of Robert Gair Co., Inc., 135 East 42nd St., New York, N. Y., has plans for new mill at Port Wentworth, Savannah, where former federal shipyard property, known as MacEvoy Shipyard, is being taken over. Plant will comprise several large multi-story buildings for pulp and paper-making divisions. Machinery and electrical equipment will be installed for large capacity. A power plant is planned. Entire development is estimated to cost over $10,000,000. Proposed to begin work this spring. J. E. Sirrine & Co., 215 South Main St., Greenville, S. C., are consulting engineers.

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Utilities Bills Taxed

Palmetto, Fla., has placed a 10 percent tax on electric, gas, and telephone bills rendered after March 15.

ELECTRICAL SPECIALTIES
FOR HEAVY INDUSTRIAL SERVICE
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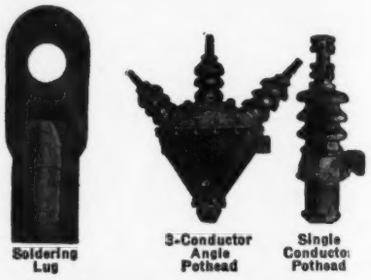

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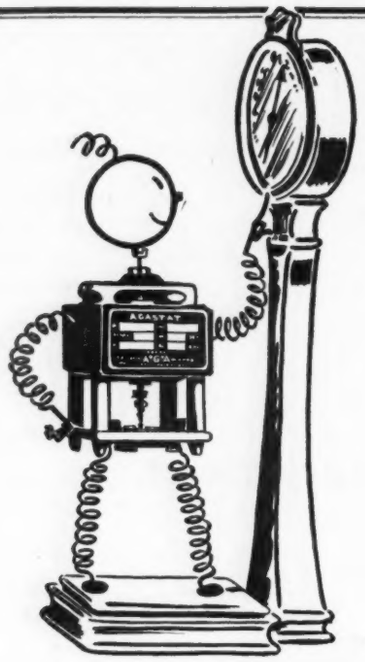

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Recent Rate Changes

ALBUQUERQUE GAS & ELECTRIC CO. has been ordered by the New Mexico Public Service Commission to reduce its rates $325,000. The commission in addition called on utility companies in Santa Fe, Las Vegas and Deming to show cause why their charges should not be reduced. Chairman W. W. Nichols signed the order for Albuquerque, effective April 1, and requested the utility to file a new schedule of rates within ten days. The commission also ordered the company to proceed with three improvement projects to cost $370,000 for which the company had established necessity in arguing against a drastic reduction of rates. Public hearings on the other New Mexico utilities will be conducted April 23, 24 and 25.

NORTHERN VIRGINIA POWER CO. has been ordered by Virginia Corporation Commission to make a reduction in electric power rates, aggregating some $124,700 a year. The new schedule will become effective on May 1, by which time, it is anticipated, the absorption of the Page and Madison Power companies and the Massanutten Power Corp. by the Northern Virginia utility will have been completed. The recent rate reduction order will affect electric power consumers in twelve counties. According to a breakdown of the savings to the various types of users made by the commission engineers, residence rates will be cut approximately $16,000 a year and the savings to municipalities in the area on their street lighting bills will amount to approximately $2,000 annually.

POTOMAC LIGHT & POWER CO., Hagerstown, Md., has filed a new rate schedule with the West Virginia Public Service Commission, which will result in a savings of $236,800 annually to its West Virginia customers.

CARROLL ELECTRIC MEMBERSHIP CORP., Carrollton, Ga., has announced reductions in power rates. Under the new schedule, the first 16 kw.-hr. or less will be billed at $1. Previously, consumers received only eleven hours for $1. The next nine kw.-hr. will cost 6 cents, the next 50 will cost 3 cents and the next 125 will cost 2 cents per kilowatt-hour. All over 200 kw.-hr. will be billed at 1.5 cents.

PORTLAND GENERAL ELECTRIC CO. and NORTHWESTERN ELECTRIC CO. have reduced electric rates for commercial light and power service, effecting a saving for Oregon customers of approximately $412,000 annually. The new rates will become effective with meter readings beginning April 24 and will benefit commercial customers in all of the utilities' territory with the exception of West Salem, Salem, Mt. Angel, Silverton and Woodburn, where similar reductions were placed in operation some time ago. About 12,500 general commercial and small industrial customers of Portland General Electric will share in estimated savings of $249,000, while the rate reduction will bring savings of about $184,000 to customers of Northwestern Electric. Designed to attract new industrial load, a new rate was also filed by PGE for large industrial power service to customers having demands of more than 3,000 kw., effective May 1. Possible savings total $78,000 annually for eligible customers who agree to take service for at least five years.

IDAHO POWER CO. rates were reduced April 1, with a resultant $300.000 annual savings for customers, it has been jointly announced by the Idaho and Oregon public utilities commissions and C. J. Strike, president of

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the company. John W. Cornell, president of the Idaho commission, said the new rates would bring a 25-cent monthly saving to the average residential user of electricity. Consumers of 200 kw.-hr. monthly or less will pay 25 cents less under the new rates. Of the 62,000 residential customers, 40,000 are in the 200-kw.-hr.-or-less class. The reductions apply largely to residential, rural, irrigation, and commercial customers throughout the Idaho Power Co.'s system. The recently acquired Jordan Valley and Long Valley electric associations will share in the new rates.

INDIANA-MICHIGAN ELECTRIC CO. residential, commercial, industrial and municipal customers have obtained reductions in electrcal rates, totaling $707,000 annually.

TUCSON GAS, ELECTRIC LIGHT & POWER CO. has been ordered by the Arizona Corporation Commission to reduce its electric rates $500,000. The effective date is retroactive to March 1. Effective January 1, 1947, the commission ordered that the rate reduction be increased to $600,000 a year.

COLORADO PUBLIC UTILITIES COMMISSION has approved a revised schedule of electric rates for Colorado Springs, bringing a potential reduction for the municipal plant's customers of approximately $62,000 annually. Henry Sherman, commission chairman, estimated a $30,000 annual cut for residential users, a similar cut for commercial customers, and $2,000 less per year on street lighting. The new schedule became effective April 1.

SOUTHERN INDIANA GAS & ELECTRIC CO. has made a voluntary reduction in its rates, effective April 1, bringing annual savings of $250,000 to customers in Evansville and vicinity. Electric consumers would save $186,000 and gas users $66,000 a year.

OKLAHOMA GAS & ELECTRIC CO. has announced a plan to reduce electric rates to public schools and city, county and state governments. President George A. Davis estimated the saving to the taxpayers would amount to $200,000 a year. The initial step in the program, Mr. Davis said, was the State Corporation Commission's approval of a reduction in electric rates to Oklahoma City.

NEWNAN (GA.) WATER AND LIGHT COMMISSION has announced a 10 percent reduction in electric rates. The new rates will result in an over-all saving to consumers of $13,000 a year, according to Roswell Atkinson, secretary of the commission. The new rates became effective with February bills.

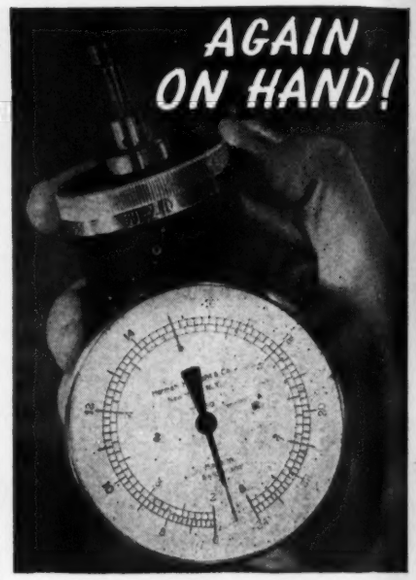
CLARKSVILLE (TENN.) CITY DEPARTMENT OF ELECTRICITY has announced a slash in electric rates, effective April 1, averaging about 20 percent.

•

Recent Legislation

MASSACHUSETTS—A bill, which would prohibit seasonal charges for electricity and gas service by utility companies and which would refer the measure to the next annual session, has been defeated in the House by a vote of 109 to 101.

NEW YORK—Among the bills which failed to pass the Legislature and in which the up-state cities had expressed a keen interest, was the Pierce-Magnuson amendment to the State Constitution. This measure would have amended Section 5 of Article 8 of the Constitution by excluding from the



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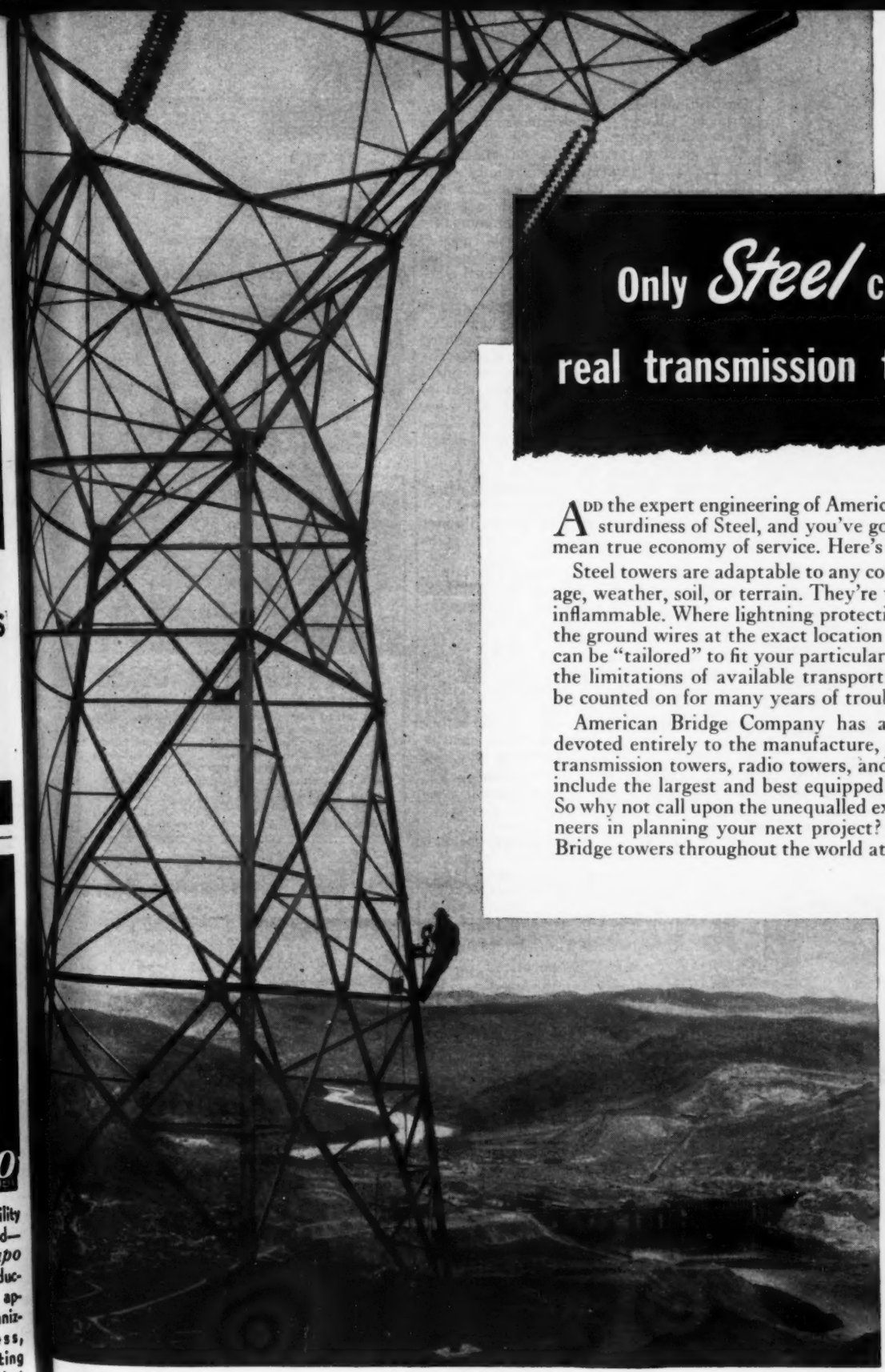

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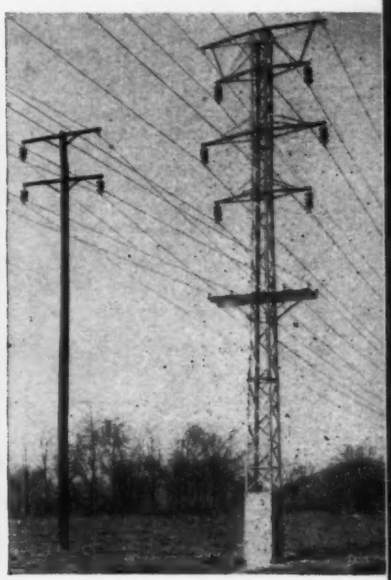

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constitutional debt limit of a county, city, town or village: "Indebtedness heretofore or hereafter contracted for the acquisition of an existing private electric system, or for the establishment, construction, extension, alteration or reconstruction of a municipal electric system, to provide a supply of electricity to the operating municipality and its inhabitants." The Pierce bill passed the Senate; the Magnuson bill was reported in the Assembly and advanced to third reading. The Pierce Bill was then substituted for the Magnuson bill and the Magnuson bill stricken from the Assembly calendar. A little later the Pierce bill was recommitted to Rules Committee where it died. The Pierce bill has been returned to the Senate dead. The Senate has passed and sent to the Governor the Dwyer bill, amends Secs. K41-48.0, N. Y. City Administrative Code, authorizes N. Y. City water supply board subject to approval of estimate board to permit use of water for generation and sale of electric current by corporation which was owner of water power site affected, acquired or damaged by plan for additional city water supply; lease may be for not to exceed 50-year period. The Senate has passed and sent to the Assembly the Burney bill, amends Sec. 101, Village Law, authorizes any village maintaining a gas, water or electric utility to establish a revolving cash fund of not more than $\frac{1}{3}$ of operating expenses for preceding year. Governor Dewey has approved the Stephens bill, amending the general city law to extend for another year power of cities of New York State to impose a tax of not exceeding one percentum of gross income or gross operating income of utilities, as chapter 342 of the laws of 1946.

•

REA Allots $1,240,000 to Eight Co-ops

The Rural Electrification Administration recently approved allotments totaling $1,240,000 to eight cooperatives in six states. These funds will be used to construct new rural electric facilities to bring electricity to 2,546 unserved farms and other rural consumers.

Details are as follows:

INDIANA—Hendricks Rural Electric Membership Corp., Danville, $55,000.

KANSAS—Leavenworth Jefferson Electric Cooperative, Leavenworth, $40,000.

KENTUCKY—Fleming-Mason Rural Electric Cooperative, Flemingsburg, $300,000.

LOUISIANA—Jefferson Davis Electric Cooperative, Jennings, $200,000.

MINNESOTA—Central Minnesota Cooperative Power Association, Clements, $245,000; Red Lake Electric Cooperative, Red Lake Falls, $200,000; Lake Region Cooperative Electrical Association, Pelican Rapids, $100,000.

MISSOURI—Consolidated Electric Cooperative, Mexico, $100,000.

•

G. E. Holders at New High

Stockholders of the General Electric Co. are at the new high record of 243,233, a rise of 7,500 over the number on March 15, 1945, which was the record then. The new figure represents an increase of 1,395 over December 15, 1945.

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Lugs, Tees, Service connectors, Grounding Clamps, Straight and Parallel Connectors, Elbows, Cable Taps, etc., etc.

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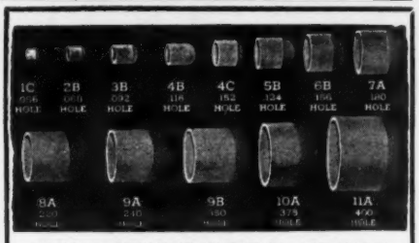

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LETTER TO THE EDITOR

Trade Name Confusion

To the Editor of ELECTRICAL WORLD:

There is something taking place in the industry which I think will retard public acceptance. I refer to the different names manufacturers are applying to the same product.

Can you imagine how confused the buying public would have been had each manufacturer thought up a pet name, instead of using radio, refrigerator, clothes washer, vacuum cleaner or dishwasher? Already our vocabulary is jammed with scientific lingo, without adding more Babel.

Today we see ads for germicidal lamps and sterilamps. Why not a common name for these de-germing lamps with ultra-violet ack ack that brings down flying microbes? That goes, too, for the waste disposal . . . garbage disposer . . . or whatever a garbage grinder is supposed to be.

Likewise, it seems that the manufacturers of these cute little breakers that eliminate fuses would hasten public acceptance if they, too, had a christening ceremony, giving their offspring a common name.

Smart men, those Home Freezer fellows!

J. H. Van Aernam,
Sales Promotion Manager
New York Power & Light Corp.
Albany, N. Y.

[Some of the recent promotional names have lent consideratble color to the product because they are so descriptive and for that reason other manufacturers have sought to overcome the competitive advantage by creating their own sales-pulling descriptive names. When there is a large number of manufacturers, as in the case of home freezers, confusion is bound to arise, especially when the trade has more or less gotten in the habit of using one name. Since a host of new current-consuming devices can be expected to come on the market in the next few years, perhaps there is some merit in the idea of establishing acceptable product nomenclature without, however, in any way hamstringing creative promotional minds.—Editors]

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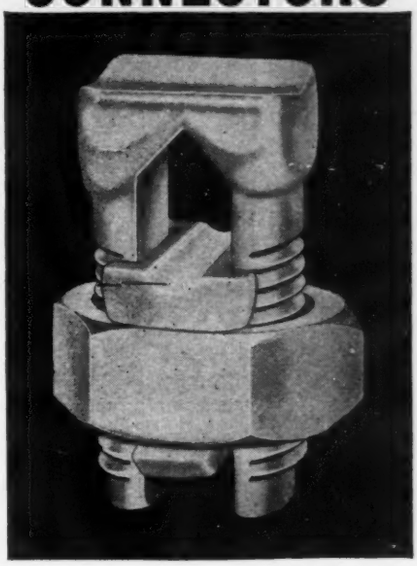
Will Air Patrol Lines

Georgia Power & Light Co. has signed a contract with the Brewster Flying Service for monthly air patrol of its power lines.

MATTHEWS NUTYPE CONNECTORS



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P-210, Electrical World
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POSITIONS VACANT

ELECTRICAL ENGINEER: Capable of estimating and constructing REA lines, with sufficient field following to develop this department. State age, experience and type of proposition desired. P-188, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

WANTED: LARGE Public Utility serving middle west with electrical and gas service has an opening for a young graduate electrical engineer with training or experience in property accounting. Position offers permanent employment, good salary and opportunity for advancement. State age, education, details of experience and salary desired. Include photo. P-214, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

WANTED: MID-SOUTH Utility Company has vacancies for electric metermen. Good working conditions, also good opportunity and security for qualified men. In writing give educational and experience qualifications, age and family status. P-230, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

WANTED: DO not answer this ad unless you can qualify. Canadian manufacturer of United States electrical products offers an unusual opportunity for young executive, ex-serviceman preferred. Applicant to be not over 35 and possess United States training in sales, manufacturing and accounting. He must have the knack of getting along with and handling fellow workers. This is a permanent position with excellent future for a man who is not afraid of hard work. Give complete details in first letter. Confidential. P-231, Electrical World—330 W. 42nd St., New York 18, N. Y.

SELLING OPPORTUNITY OFFERED

WANTED: YOUNG aggressive salesminded graduate Electrical Engineer, with sales engineering experience, to assist senior sales executive in Ohio Combination Utility Company. Must have experience in sales training, rate applications, power and lighting sales, and possess a pleasing personality. SW-203, 330 W. 42nd St., New York 18, N. Y.

EMPLOYMENT SERVICE

SALARIED POSITIONS $2,500-$25,000. This thoroughly organized confidential service of 36 years' recognized standing and reputation carries on preliminary negotiations for supervisory, technical and executive positions of the calibre indicated, through a procedure individualized to each client's requirements. Retaining fee protected by refund provisions. Identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 262 Dun Bldg., Buffalo 2, N. Y.

(Continued on opposite page)

EXPERIENCED WATCH ENGINEERS AND FIREMEN

For New Steam Electric Generating Station

Must be familiar with pulverized fuel. Plant located at Beloit, Wisconsin. Write to

Personnel Department

WISCONSIN POWER & LIGHT CO.
MADISON, WISCONSIN

WANTED

POWER PLANT SUPERINTENDENT

Power plant superintendent under 45 years of age, experienced in high-pressure plant operation, maintenance, and labor relations. Permanent connection, company in middle-west, residence in middle-size industrial community, salary $6,000. Write education, experience, references.

P-226, Electrical World
520 North Michigan Ave., Chicago 11, Ill.

WANTED

PURCHASING AGENT

An electric utility company in the middle west has excellent opening for executive with right qualifications. Prefer engineer, under 40, with utility experience. Send particulars of education, experience and salary expected.

P-227, Electric World
520 North Michigan Ave., Chicago 11, Ill.

WANTED

ELECTRICAL ENGINEER

For Power Plant Design
Must have Public Utility Experience

WESTCOTT & MAPES, INC.
New Haven, Connecticut

WHEN *Answering Advertisements*

PLEASE *do not send original letters, certificates or photographs. We cannot be responsible for their return. Please send photostat or carbon copies.*